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389 — *Journal Section of the American Society of Heating and Ventilating Engineers*

Piping is industry's greatest transportation system—see page 363

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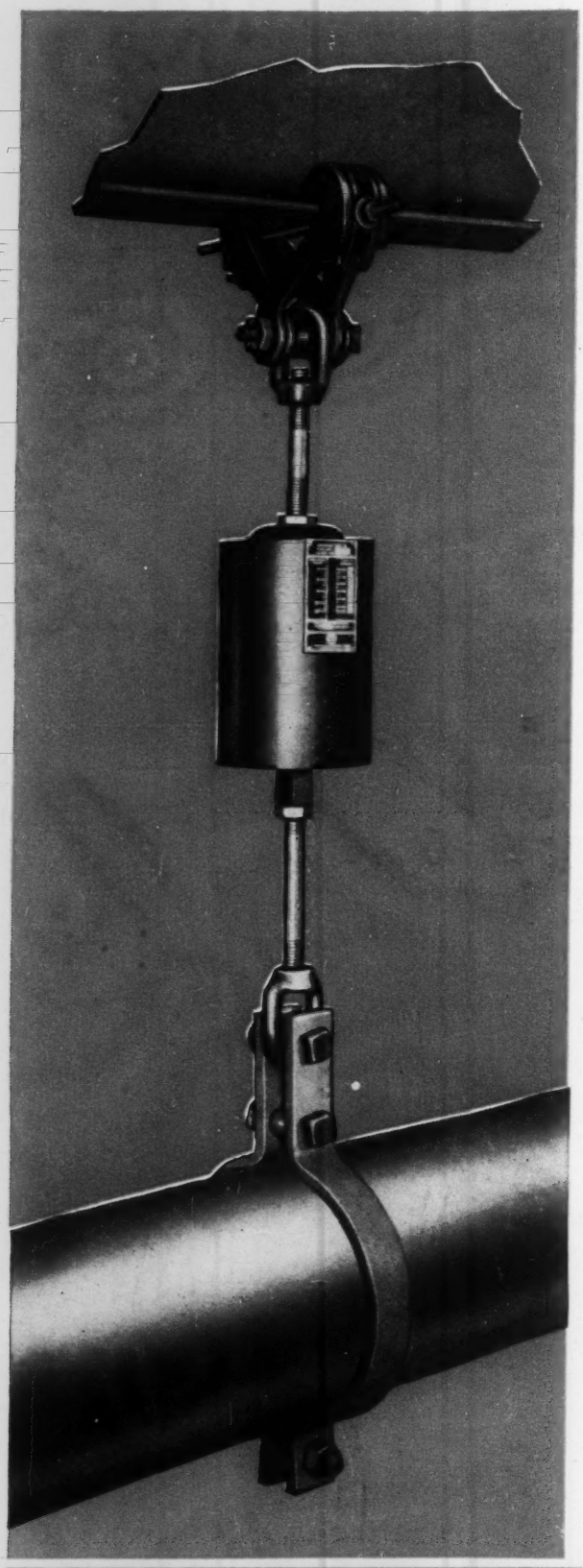

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WHENEVER **PIPING** IS INVOLVED

PIPE LINE SUPPLIES CIVILIAN PETROLEUM

The Little Big Inch, war emergency pipe line which previously had been used principally to move military gasoline, has begun supplying civilian petroleum products to the Atlantic seaboard, Deputy Petroleum Administrator Ralph K. Davies announced last month. The greater part of its deliveries for the summer will consist of house-brand gasoline, kerosene, and heating oil, he said.

HYDROGEN GAS VENTED FROM HEATING SYSTEM

In his recent presidential address before a London meeting of the Institution of Heating and Ventilating Engineers, Dr. Oscar Faber reviewed some of the lessons derived from 20 years of heating and ventilating experience. His paper was published in the March-April issue of the IHVE's journal, received last month.

One experience which was certainly unusual was reported by Dr. Faber in describing Dolphin Square, "probably the largest block of flats in London." The radiators near the top were constantly requiring venting, and it seemed impossible to account for this as it continued long after it was supposed that all of the air contained in the water prior to heating up had been allowed to escape.

Investigation revealed that the gas escaping from the vents was hydrogen, instead of air, and could be ignited at the air cock to burn with a blue flame. The presence of hydrogen was attributed by Dr. Faber to the rusting of iron in the pipes and radiators, which abstracted the oxygen from the water, leaving hydrogen free. The hydrogen was important enough to require automatic air vents, which were carried up into boxes on the roof.

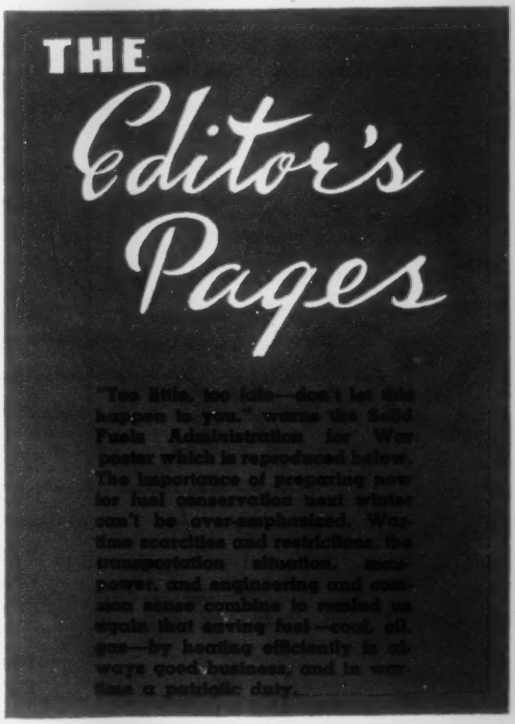
Much of Dr. Faber's remarks pertained to the air conditioning, ventilating, and panel heating installations in the Bank of England, for which he was the engineer for the structure and the mechanical and electrical services. The bank has its own diesel engine driven electric generating plant, and "owing to the adoption of panel heating with its low temperature of circulating water (110 F) it was found possible to utilize this water for the cooling of the diesel engines." Not only is the heat delivered to the cylinder jackets thereby rendered useful, but also the exhaust gases deliver into waste heat boilers. The distribution of heat is then somewhat as follows, according to Dr. Faber: Converted into electricity, 30 per cent; collected from cylinder jackets, 30 per cent; collected from waste heat boilers, 15 per cent; waste 25 per cent.

IBR HEATING RESEARCH PROGRAM CONTINUED

Members of the Institute of Boiler and Radiator Manufacturers have authorized the continuation of their research program at the University of Illinois, revised the IBR rating code, and launched other educational activities designed to establish a secure foundation for future sales.

The contract between the IBR and the university has been extended to cover the year from July 1, 1945, to June 30, 1946. The major project for the next heating season will involve a study of the performance of an automatically fired, one pipe, steam system which will be installed in the research home this summer. Recessed radiators will be used during the first part of the test, with a change later to a radiant baseboard.

Among the more important objectives of the study will be to determine if a main less than 2 in. in diameter can be used on a system of this size; to determine the operating characteristics of vacuum and nonvacuum types of valves for the venting of radiators; to determine the advantages of splitting the system into two circuits as compared with one circuit; to determine fuel savings effected by preventing the circulation of air through the boiler during off periods; and to determine fuel savings resulting from the use of outdoor air for the burner and draft regulator. Also included in the general objectives will be a comparison between a one-pipe steam and a hot water heating system with respect to "cold 70."



ROLAND WARE IS DEAD

Roland R. Ware, president and general manager of Clarage Fan Co., Kalamazoo, Mich., died last month following several weeks of critical illness. He was 61 years old, and had been actively identified with Clarage for over 40 years.

SPRARAGEN DIRECTS WELDING RESEARCH

The Welding Research Council of the Engineering Foundation has announced the appointment of W. Spraragen, executive secretary of the council, to the newly-created position of director. The council is a cooperative scientific research organization which is engaged actively in the study of matters related to the science and art of welding. Sponsored by the American Welding Society and the American Institute of Electrical Engineers, it operates in close cooperation with all major engineering societies. It has an annual budget of more than a quarter of a million dollars and these funds for research are provided by large users of welding and welded products, and governmental agencies.

An important duty assigned to Mr. Spraragen in his new post will be the administration of the work of a pressure vessel research committee now being organized which contemplates the expenditure in this field of $225,000 over a three year period.

THE *Editor's Pages*

SEES BIG DEMAND FOR AIR CONDITIONING

In addition to the huge demand for new mechanical refrigeration and air conditioning equipment after the war, American business, commercial, and industrial establishments will spend millions of dollars for repair, modernization, and expansion of existing equipment, according to F. J. Hood, president of the Refrigeration Equipment Manufacturers Association, who based his estimate on a recent report to the organization by H. T. McDermott, secretary of the Refrigeration Service Engineers Society. More than $70,000,000 in new parts will be required, and to that sum will be added many millions in labor and engineering services.

As an example of the existing situation in major industries, Mr. Hood pointed out that over half the refrigerating equipment used by the meat industry is 15 years old or more. This means, he said, that a large percentage either is badly in need of repair or should be replaced as soon as possible.

"The great strides made in refrigeration and air conditioning since the start of the war and as a result of wartime needs will make it worthwhile for many concerns to install complete new facilities, so great will be the dollar-for-dollar advantages," Mr. Hood declared. "On the other hand, it may take years for our industry to catch up with the accumulated demand for new equipment of all types, and often it may be advisable to repair, enlarge, or modernize present installations, even if on a temporary basis. Then, thousands of comparatively new prewar installations will require servicing attention, at least to some degree."

PLANS FOR RETURNING VETERANS

Plans for the return of 1200 Detroit Edison Co. employees on military leave from the company have been completed, James W. Parker, president, has announced.

"Our plans recognize three simple facts," Mr. Parker said. "Veterans do not wish to be segregated and treated as a group apart; each veteran is anxious to resume his own individuality, each has his own ambitions and hopes; while immediate reemployment is vital to him, he is more concerned with the years ahead."

In a message to each employee in the service, the company is now advising that he will be restored to his former position or, if qualified, to the position to which he would have been raised by promotion had he not been away. His wage rate will include raises granted to his job while he has been in the service. If the man's position has been discontinued, the company will endeavor to find another of like seniority status, and pay. Life insurance, retirement plan benefits, immediate vacation with pay, and sick leave benefits will automatically be restored. Other benefits, such as additional insurance and hospital and surgical insurance coverage for the family, will be available.

Apprentice training courses will be accelerated 20 per cent for returned veteran employees who were enrolled before leaving for military service. The plans are flexible and designed to offer the best opportunity to each veteran. Some men will want refresher courses, some will have acquired new skills, others will wish to complete their apprenticeship training courses, and some will require and receive special consideration because of wounds or illness contracted in the service, according to Mr. Parker.

AIR CONDITIONING AIDS ARMY BATTERY TESTING

In the eyes of the Army, a battery or cell is only as good as its capacity to withstand the hard conditions of war. To determine in advance how much punishment cells and batteries can take and to foster improved manufacturing processes which will increase their ruggedness and lengthen their life, the Signal Corps ground signal agency, Bradley Beach, N. J., has developed ultramodern testing apparatus and methods. The battery test branch works on a 24 hr per day, seven day per week schedule. Electrical, physical, and storage tests at temperatures ranging from arctic to tropical conditions on both primary and secondary batteries are accomplished here in accordance with Signal Corps, Navy, Ordnance and Bureau of Standards specifications.

Since temperature is vital in battery testing procedure, the battery test branch utilizes 27 temperature controlled cabinets, six air conditioned rooms, and two temperature controlled rooms for the storage and test of the various types of batteries which are received. Much of the testing equipment provides for automatic control of temperatures, humidities, and cycling times.

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Editor
C. M. Burnam, Jr.

Advertising Staff

Wallace J. Osborn
New York
Telephone: Murray Hill 9-8293

James D. Thomas
Chicago
Telephone: State 6916

Robert A. Jack
Cleveland
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Telephone: State 6916

Publisher
Frank P. Keeney

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Front cover photo—Control desk in a station on the Little Big Inch pipe line (see page 363)

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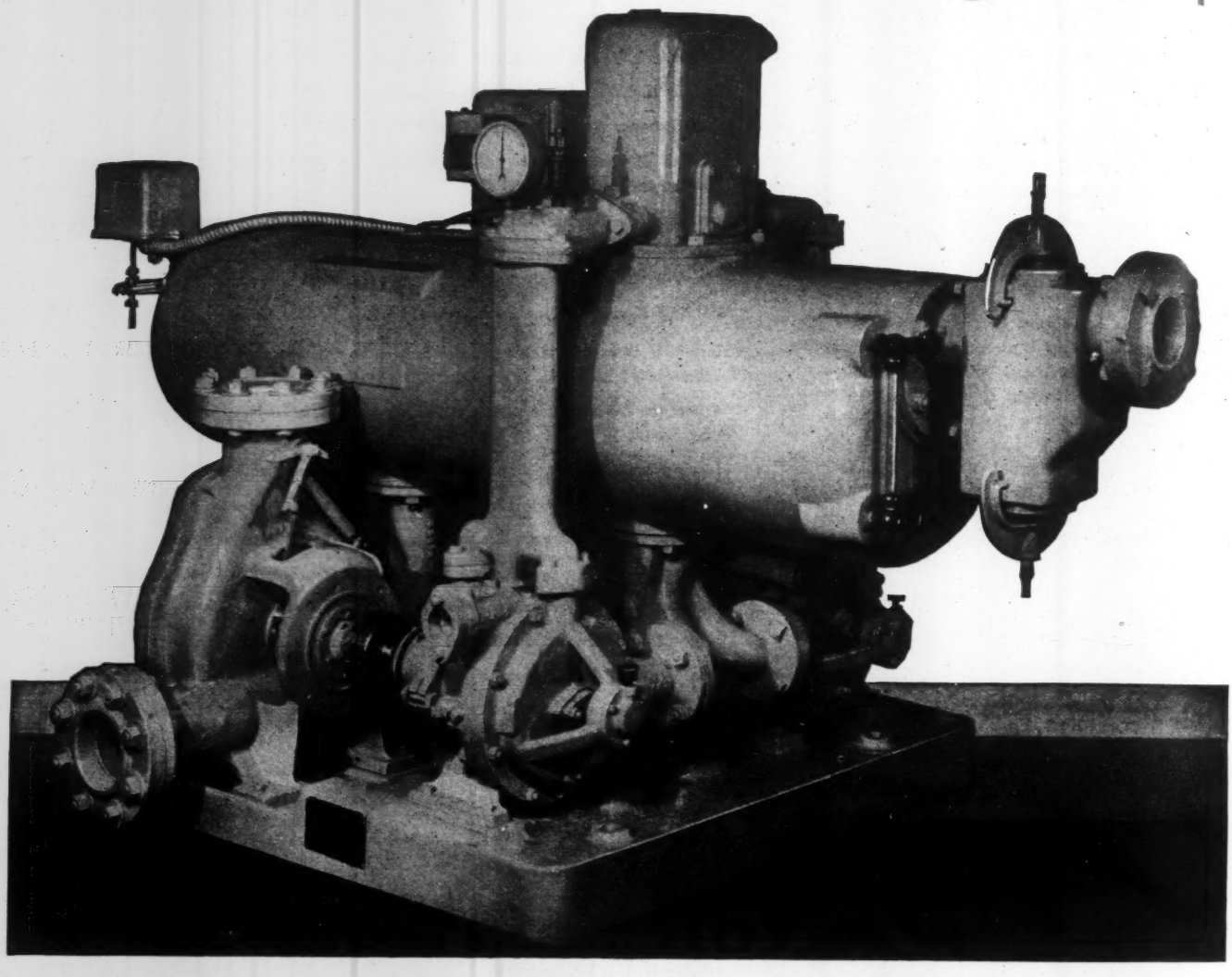
Where Heat Must Not Fai– Install this SAFE Heating Pump!



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is entirely independent of electric current failure, and continues to operate as long as there is steam in the system.

More than that, the Vapor Turbine is a most economical pump, for the elimination of electric current does away with current cost, the largest single item in the operation of an ordinary return line heating pump.

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SOUTH NORWALK, CONNECTICUT, U. S. A.

THE BIG INCH PIPE LINES
. . . a Double-Barreled Gun

WE'VE OFTEN pointed out in these pages that "piping is industry's greatest transportation system." Perhaps there is no better example of this than the Big Inch and the Little Big Inch pipe lines—comprising a long-range weapon that has been pointed straight at the heart of Germany and which contributed greatly to the defeat of the Nazis. . . . These pipe lines, representing one of man's greatest pumping jobs, have many interesting engineering features, a number of which are reviewed here. This article has been taken from a recent talk given before the Michigan section of the AIEE by Merritt A. Hyde, petroleum engineer, Westinghouse Electric Corp.

AMERICA HAS a long-range weapon that is by far the largest of its kind; a double-barreled gun that has been pointed straight at the heart of Germany. One barrel of this rifle is 2 ft in diameter. It's called the Big Inch pipe line, and it shoots a stream of crude oil, some 320,000 barrels per day, from the great producing area in the southwest to the refineries on the eastern seaboard. The second gun barrel is a mere 20 in. in diameter, so it is known as Little Big Inch. It spews about 225,000 barrels per day of gasoline from the refineries of the Gulf coast to New York harbor.

Big Inch is a 1400 mile underground conduit, 24 in. in diameter for 1264 miles of its length, from Longview, Texas, to Phoenixville, Pa. There it forks into two 20 in. lines, one to the Philadelphia area, totaling some 40 pipe miles, the other about 90 miles to the New York area. The route encounters all varieties of terrain, ranging from the Mississippi bottoms to the ridges of the Alleghenies. Between an elevation of about 300 ft at Longview and sea level at its eastern terminals, its highest point is the 2900 ft Laurel Hill crossing, in Pennsylvania.

Operating at capacity, the line carries a continuous 1400 mile column of oil, more than 4,000,000 barrels of it, weighing 600,000 tons, moving at a speed of about 4¼ mph. To accomplish this requires a total propelling force equivalent to about 4000 tons. This force and rate of motion represent the expenditure of nearly 100,000 hp, by that measure one of man's greatest pumping jobs.

The task is performed by electrically driven centrifugal pumps. The aggregate installed motor capacity applied to mainline pumping is approximately 120,000 hp, in 80 units of 1500 hp each, in 26 stations at intervals averaging about 52 miles, with generally three units per station. Additional spare and auxiliary units bring the total installed horsepower to about 130,000.

Even in these days of big numbers, the installation of 130,000 hp of motors in a pumping plant is something unusual. However, the real interest in this project is not in its size, but in the nature of its operation. It is one thing to build a 130,000 hp pumping plant on some particular site; it is quite another matter to set up the same capacity in 26 separate stations performing a single pumping operation, yet extended over a 1400 mile strip of ground.

The whole character of pipe line operation stems from subdivision into stations separated geographically but joined physically. The use of a number of stations along the line instead of one station at the origin is dictated, of course, by the necessity of limiting the station delivery pressure to a value that develops a piping stress within the allowable limit.

Pipe Line Pressures

Considering the section of line between Longview and Phoenixville, if the pumping capacity could be combined into one station at Longview, delivering 300,000 barrels per day through 1264 miles of 24 in. pipe, with a pressure drop per mile of 12 psi, and against a static head of 50 psi due to net difference in the two station elevations, then Longview station would have to operate with a discharge pressure of some 15,250 psi. Of course, this is an impractical condition from the standpoint of pipe design alone. But by dividing the job among 24 stations along this section of the line, the average net pressure developed at each station becomes about 635 psi. Allowing for a suction pressure at each station of 50 psi, the station discharge pressure would be 685 psi. In actual operation, capacity flow is somewhat higher than the 300,000 barrels per day nominal rating of the line, and the net input pressure at each station is in the neighborhood of 675 psi. With a suction pressure of 50 psi, this means a maximum line pressure at the station discharge of 725 psi, a practical value from the standpoint of pipe design.

The average spacing for 24 stations over this 1264 miles of line is 52.5 miles; actual distances between stations vary from 31 to 78 miles, the spacing being closer for uphill and wider for downhill terrain. In each case the space is such that the pressure increment developed by the station is equaled by the static head difference between that station and the succeeding station, plus the friction drop at capacity flow for the length of piping between the two stations.

Below—Reduced voltage switchgear and three 1500 hp, 1780 rpm motors driving main line pumps on 24 in. line. Each drive is through a rotating seal in the partition separating the pump room from the motor room

For a given capacity, fluid condition, and pipe condition, the friction pressure drop per mile is fixed. For interchangeability of pumping equipment it is desirable to maintain essentially uniform station input pressures throughout the line. Under these conditions the station sites are determined by the hydraulics of the line, without much flexibility for convenience in other respects.

It is to be expected that a variety of power service conditions would be encountered. Power is delivered to the station sites by 16 different utility companies. Service voltages range from 22,000 to 110,000 volts. From the outdoor substation, power enters the pumping station switchgear at 2300 volts. In this switchgear it passes through a main breaker and thence to a bus from which it is tapped to each motor through suitable starting equipment. This starting equipment is of the full voltage type wherever the power service facilities are adequate to handle the across line starting current of the motors, which is about five times the full load current. The current demand for the station with two units operating at full load and the third unit starting at full voltage, is about 200 per cent of the running current for three units. In 13 of the 26 stations, reduced voltage starting was deemed necessary. The more elaborate starting equipment in these stations reduced the maximum demand during starting to about 150 per cent of the running current for three units.

Minimizing Starting Torque

The torque requirement for acceleration is minimized by starting the pump with the suction valve open and the discharge valve closed. The static torque is less than 20 per cent, and as the pump accelerates, the load torque increases as the square of the speed, from substantially zero after breakaway to about 45 per cent at full speed with the discharge valve closed. After the unit reaches full speed, the discharge valve is opened, and normal running load follows.

These motors, having pullout torque about twice full-load torque, can carry the pump at full load through a substantial voltage dip—down to a voltage approximately 70 per cent of normal. Within that range the starting of one unit does not affect appreciably the operation of other units which may be running. This means that for a particular pumping station the choice between across line starting and reduced voltage starting is determined by the ability of the power system to handle the starting demand with acceptable voltage service to other power users on the system.

Each motor control unit provides time delay undervoltage protection, and also instantaneous short circuit protection, and locked rotor protection. Running load protection is provided by a thermal relay which follows closely the heating characteristic of the motor.

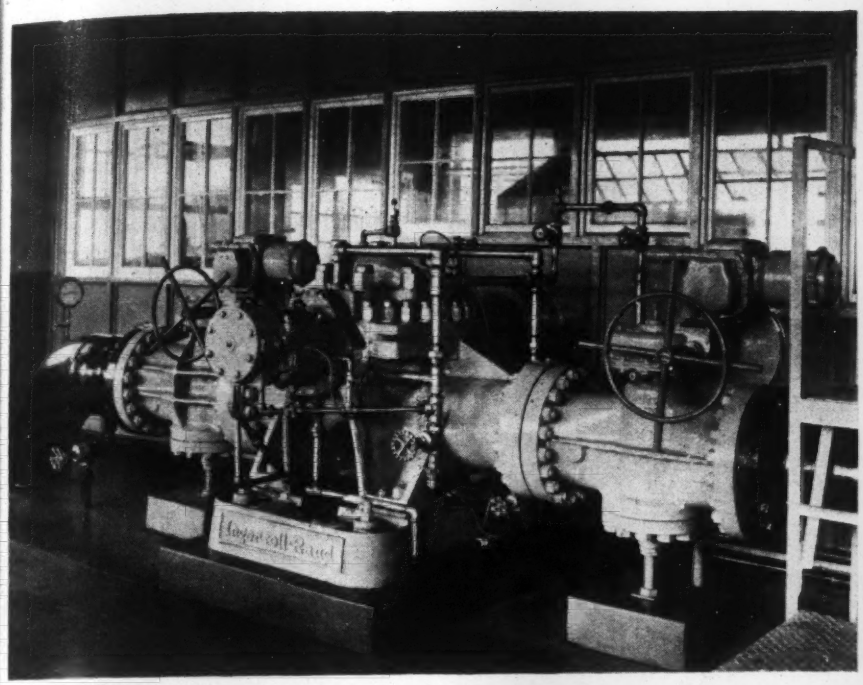
Motor Ventilation Air Heats Station

The motors are of the squirrel cage induction type. Their ventilation is by air intake at both ends, with discharge through an opening in the top of the motor frame. Each motor is installed with a so-called "top hat" through which the warm discharge air is drawn into a duct and expelled through the roof by a small motor driven blower. Provision is also made for circulation of this air as a means of heating the station in cold weather.

The pumps are surprisingly compact. They are single stage, 16 by 12, rated 8750 gpm, 648 ft head, at 1780 rpm. Each pump is equipped with a suction valve and a discharge valve. These are manually operated; the 16 in. suction valve requires 156 turns for its complete travel, and the 12 in. discharge valve 118 turns.

From the standpoint of electrical devices and wiring, the pump room is a hazardous atmosphere location, made so by normal discharge from the pump glands, by pump casing venting operations, and by any abnormal leakage that may occur. The push-buttons in the pump room for starting and stopping the units are of the explosionproof type.

The main 24 in. pipe enters and leaves the station site at a scraper box where dead end traps are located for the handling of incoming and outgoing scrapers, employed to clean the line. By suitable valve positioning, the stream is detoured around the scraper traps and through the station, where it receives the pressure increment developed by the pumps



and resumes its travel along the line. Check valves permit bypassing the individual units or the station.

The starting and normal stopping of the stations and of units within stations are entirely by direction of the dispatcher, who is located in the headquarters office at Cincinnati. Continuous intercommunication between the dispatching office and all stations is provided by telephone with loud speaker to permit conversation between the dispatcher and all operators.

All Control Centralized

Here electrical control performs a superior job, for the operator has at a central location in the pump room, grouped with the principal pressure gages, the three pushbuttons controlling the pump units. So in prompt compliance to the dispatcher's instructions, and without having to lift his glance from a gage, he can operate a pushbutton to start or stop each unit. When starting up, the pump is up to speed within 10 sec and ready for its discharge valve to be opened. Flexibility and speed in starting and stopping are important contributions by electrical control to the operation of the line.

Of still more importance is the adaptability of electrical control to protective shutdown functions. It is necessary at all times to hold the operating pressures between definite limits of low suction and high discharge pressures.

Low suction pressure permits vaporization of the liquid in the pump casing, followed quickly by possible damage to the pump through gland heating and unbalance. To guard against this, a relay is provided, having a pressure element connected to the station suction. Its contacts sound an alarm at about 35 psi, thus warning the operator, who may be able to correct conditions by throttling adjustment. Failing this, a second low pressure relay functions at about 20 psi to cause shutdown. Both of these devices are adjustable to higher or lower settings.

To prevent unnecessary shutdown of the full station capacity, this shutdown relay is arranged to stop the units in timed sequence, beginning with the downstream unit, with an interval of about 5 sec between shutdowns. If upon shutting down a unit, the station suction pressure rises above the reset point of the protective relay, the remaining units are allowed to continue in operation. However, if the suction pressure persists below the protective relay setting, the remaining units are stopped automatically in sequence at 5 sec intervals.

Protection against excessively high line pressure at the station discharge is provided by a pressure actuated relay, similar to the low suction pressure relay, and set to function when pressure exceeds about 750 psi. For additional protection of station equipment and piping, a pressure relay between unit No. 2 and unit No. 3 will allow a pressure at this point not more than 300 psi above normal discharge pressure of unit No. 2. This high pressure protective relay also will shut down successive units in timed sequence.

In event of a protective shutdown due to abnormal pressure, the operator may have difficulty in identifying the particular relay that functioned. To provide this information quickly, a visible annunciator was designed, for mounting right in the pump room, in an explosionproof housing, adjoining the station pressure gages and the pushbuttons which control the three pump units.

With these protective devices, the station can operate at a wide range of pressure conditions within the limits for which the devices are set, and yet have the benefit of protective shutdown when some abnormal condition results in pressures exceeding the prescribed limits.

Little Big Inch Packs Bigger Wallop

And now let's take a look at Big Inch's rival, the 20 in. refined-products line. Called Little Big Inch, because it's a trifle smaller in the waist, it is 200 miles longer, and it really packs a bigger wallop than Big Inch, for its 225,000 barrels per day of refined products represent the equivalent of some 375,000 barrels of crude oil.

Little Big Inch, drawing products from 11 refineries in the Gulf coast area, runs 350 miles from Beaumont, Texas, to Little Rock, Ark., where it joins the right of way of the 24 in. line and follows it from there on to the east. Be-

Above—On the 20 in. line, the suction and discharge valves of each pump are motor operated, and the complete pumping unit, with valves, is controlled by a single "start-stop" pushbutton

ginning at Little Rock the 20 in. line stations are at the same sites as the stations on the 24 in. line. Thus substantial savings are effected in costs of right-of-way, station sites, power procurement, energy, operating labor, and maintenance.

Station layout on the 20 in. line is quite similar to that of the 24 in. line. However, the handling of refined products entails the addition of filter units. The principal differences in the 24 in. and 20 in. station designs lie in the system of station control, occasioned largely by the greater precision justified in products line operation to minimize contamination between products.

Power service facilities are entirely similar to those of the 24 in. line. The transformers for the two stations at each site operate from a common primary feeder with independent secondary circuits to the respective pump houses.

The pumps are driven by 1250 hp motors at 3575 rpm, similar to the 24 in. line motors in ventila tion arrangement. Like the 24 in. line motors, these units are coordinated as to mounting dimensions, so that all main pump motors on the line are mechanically interchangeable, regardless of manufacture.

The pumps are single stage, 14 by 12, operating three units in series, designed to handle 235,000 barrels per day of gasoline, developing a total pressure for the three units of approximately 700 psi.

In addition to low station suction pressure and high station discharge pressure protection, there is a pressure relay connected immediately upstream of the station throttling control valve. If excessive pressure occurs at any of these points, the relay stops whichever unit is operating as the final unit in the station, and, if pressure conditions are not restored to normal within about 5 sec, then it proceeds to stop the next unit in time sequence, and finally, if abnormal pressure still persists, it stops the remaining units.

Temperature actuated relays are employed in all pump casings, pump bearings, and motor bearings, and on the motor windings.

In general each protective relay actuates circuits to perform three functions: (1) sound an alarm, (2) energize an indicating light to identify the protective device that operated, and (3) stop the unit, or the station.

A feature in line with recent practice on other products lines is the provision for throttling at the station discharge under automatic control by pneumatic controllers. This control is designed to throttle the station discharge when necessary to maintain the station suction pressure above a predetermined low limit, say 30 psi, or to maintain the line pressure beyond the station discharge below a predetermined pressure, say 700 psi.

Nerve center for all these control operations and protective functions is the station control desk, and the associated sequence control cabinet (see photo on front cover). The circuits from the pump and motor rooms, from the lockout pushbuttons at the pumps, from the motor operated valves, and from the protective pressure relays and thermal relays, all converge in the station sequence control cabinet. Here are assembled the necessary electrical devices to translate the incoming impulses into proper action by the switchgear, valves, auxiliary blowers and, when desired, by the station alarm. At the same time, the station sequence control equipment sets up proper circuits to the control desk to keep the operator informed by indicating lights as to the functioning of the various apparatus.

Pump room of typical Big Inch station

From the control desk all major operations of station control are performed. Installed in the partition between the control room and the pump room, it is surrounded by a large glassed area permitting view of the pumps and motors. To increase this view, the gage-panel section is designed low, so that the operator can look over the top of the unit.

The gage panel section consists of a compartment having rear doors opening into the pump room to permit servicing the hydraulic instruments. The front is a panel surface facing the control room, on which these instruments are mounted, sealed with gaskets. This gage panel compartment is gasketed into the partition to prevent seepage of hazardous vapors into the control room, and, as an

additional precaution, the control room is kept under a small pressure of clean air drawn from the outside of the building.

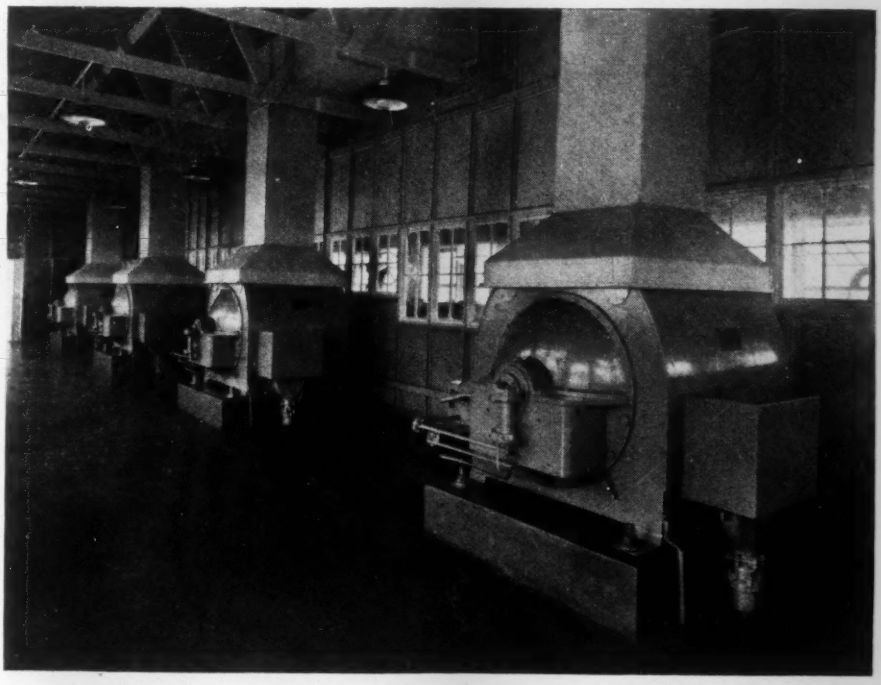
Control Desk Shows Piping Layout

The electrical section of the control desk is really a separate unit isolated from the gage panel compartment, located entirely within the control room and therefore not exposed to the hazardous atmosphere of the pump room. On this desk are mounted pushbuttons and indicating lights for the master station control. The desk top surface is a sheet of transparent plastic, backed with a schematic design of the main piping, and showing the pumps, valves, and driving motors.

From a single "start-stop" pushbutton, the operator controls each pump unit, the valve motor control and pump motor control automatically functioning in their proper sequence for starting up and shutting down. Indicating lights in the desk top diagram show the valve positions, and small illuminated arrows show the actual course of the stream through the station piping in accordance with the particular units operating.

If trouble should develop at any of the protective device locations, a small red indicating lamp appears at the appropriate spot in the station diagram, and the operator is given an audible signal. In general the protective device automatically shuts down the particular unit involved, or the station. In each case the audible signal continues until it is silenced by an alarm cutout button on the desk, and the particular indicating light continues to burn to tell the operator exactly where the trouble is, until it is extinguished by reset of the protective device, when the trouble is cleared.

This desk and the associated system of control greatly simplify the duties of the station attendant, increase the reliability of station operation, and facilitate location of the trouble spot in case of abnormal shut down. Checking continuously the pulse and the temperature of the station equipment, the desk has been called, rather appropriately, "The pipe line nurse."



1250 hp pumping motors in four unit 20 in. line station

★ ★ ★ ★ ★ ★

Ickes Stresses Great Need for Fuel Conservation

Solid Fuels Administrator Harold L. Ickes announced June 27 that a new survey indicated that this fuel year's estimated hard and soft coal requirements would exceed expected production by about 37,000,000 tons, even though Germany has been defeated. Coke, too, will be extremely short as a heating fuel, because of the heavy demands for use in the manufacture of steel.

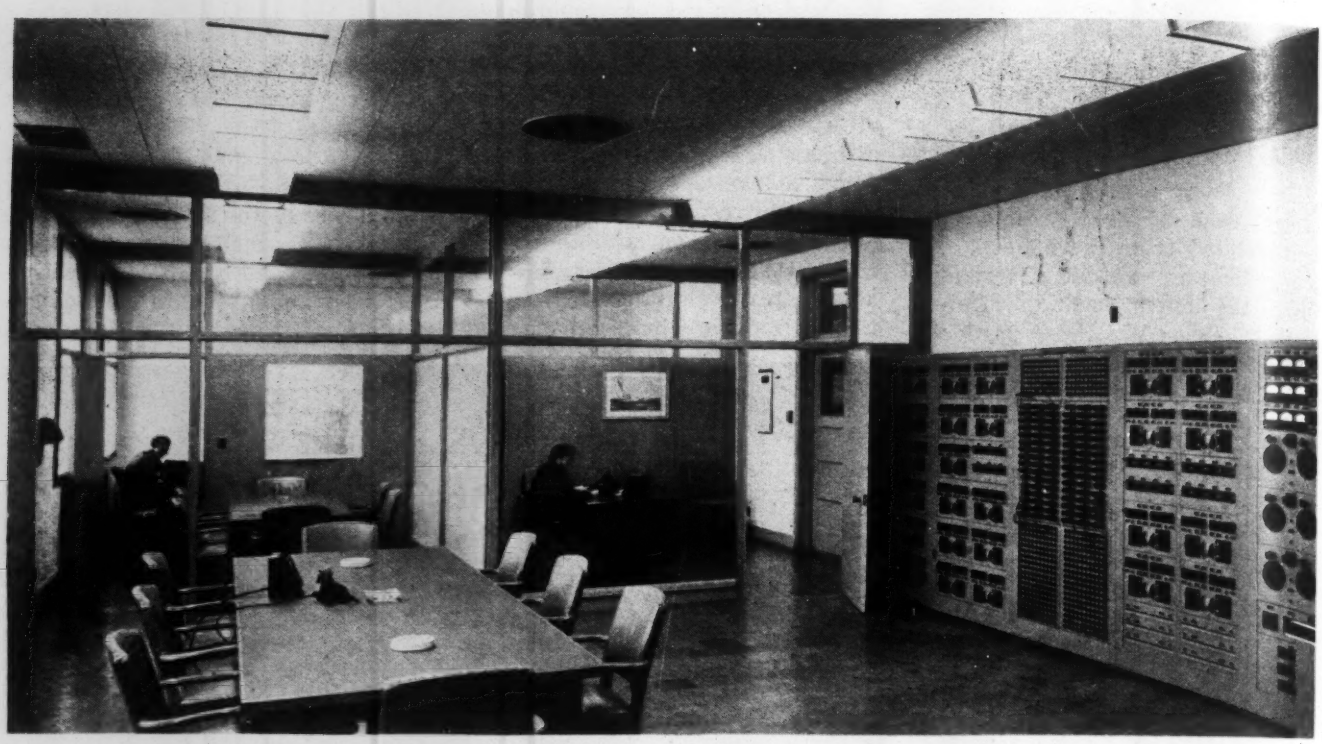
"This means that there is no increase in sight in the wartime quotas established for domestic users of the scarce eastern-mined coals and byproduct coke," Administrator Ickes said. "Millions of householders who depend entirely upon the scarce coals will have to conserve fuel rigidly in order to stretch their supply so as to get along next winter on four tons for every five normally burned. The alternative would be to deprive industry of coal, at the risk of impairing war activities or disrupting production of civilian goods.

"I can see nothing ahead but the need for the most rigid conservation of fuel by the American public. It is time right now to make homes and buildings heat tight and place heating equipment in good order, so that fuel can be saved without undue discomfort next winter."

War and Navy Departments Issue Guide for Prime and Subcontractors

An outline for contractors which suggests methods of advance planning and practical procedures for settlement of terminated contracts has been published jointly by the War and Navy Departments.

This 59 page booklet contains standard proposal forms, a list of Army and Navy field officers, and other pertinent data on settling terminated contracts. Copies may be obtained without charge by writing to the Readjustment Distribution Center, 6th floor, 90 Church St., New York 7, N. Y., attention: Lt. E. P. Lull.



The 13th alternating current network calculator in the world was officially dedicated last month

Intricate Electrical Network Calculator Is Housed in Air Conditioned Laboratory

AN ALTERNATING current network calculator—the 13th in the world—was officially dedicated at Illinois Institute of Technology, Chicago, last month. The giant calculator was purchased and installed in a specially designed, air conditioned laboratory at a cost of approximately $90,000. Seventeen companies cooperated to make the calculator's acquisition possible through their purchases of time on a unit basis extending over a period of 12 years.

Capable of duplicating any existing or proposed power system, the calculator can solve difficult problems in system operation and design accurately and with a saving of hundreds of hours formerly consumed in mathematical computation. It is an intricate device for creating and testing miniatures of a power system in order to determine the effect of additional loads, methods by which additional loads may be carried, or changes which can be made. Complete data on the system to be studied are assembled and reduced to calculator values. The circuits on the calculator are then connected in the same manner as the generators, lines, transformers, loads, etc., on the power system and adjusted to have equivalent characteristics.

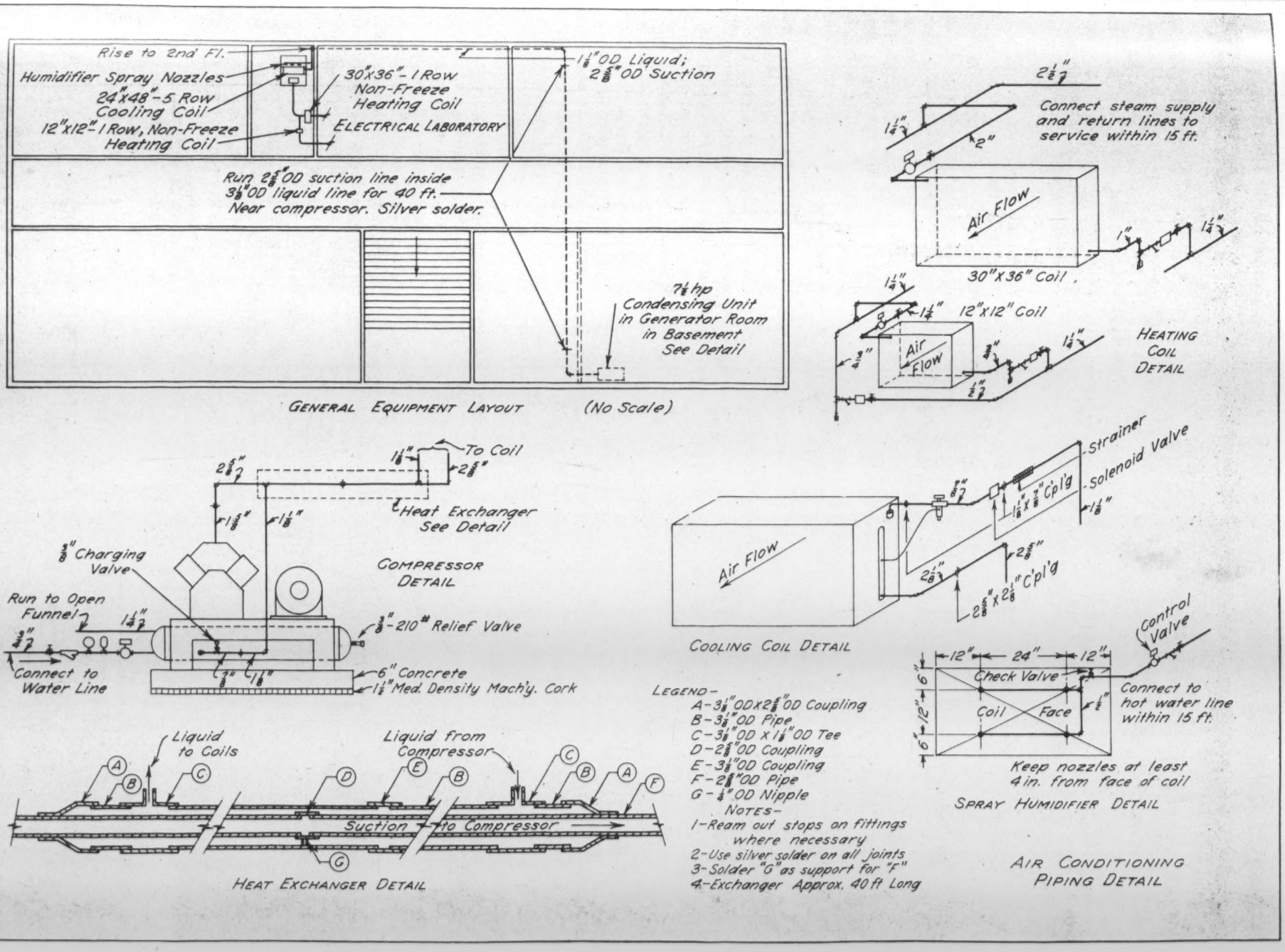
When all of the known system operating conditions are matched by values on the calculator, which can be read accurately at the meter desk, the entire setup is a correct representation of the power system. The voltages and loads on all circuits of the calculator can be measured accurately, giving information not otherwise readily available because measuring equipment is not usually available at all points on the power system.

Thus, the calculator does not calculate in the mathematical sense, but rather replaces extensive and impracticable calculations by direct measurement of voltages, currents, and so forth, in a miniature electrical replica of the system.

Air conditioning, fluorescent lighting, and plate glass partitions offer practical as well as comfortable laboratory space. The laboratary in which the calculator is contained consists of two conference rooms, a reception room, quarters for the machine which makes black and white prints, and the large room in which the calculator is installed. Files for system data and other reference material are maintained in this room.

The calculating board itself is composed of 12 metal cabinet sections covering 40 ft of wall space; each section is 7 ft high. Controlling the board is the metering desk which contains the instruments for accurate measurements. Enough circuit elements are present in the calculator to represent simultaneously 12 generating stations, 100 line sections or transformers, 40 loads, and 18 variable ratio transformers. Two small d-c calculating boards are also available.

A 7½ hp air conditioning sys-


Rise to 2nd Fl.
Humidifier Spray Nozzles
24"x48"-5 Row Cooling Coil
12"x12"-1 Row, Non-Freeze Heating Coil
30"x36"-1 Row Non-Freeze Heating Coil
ELECTRICAL LABORATORY
1⅛" OD Liquid; 2⅝" OD Suction
Run 2⅝" OD suction line inside 3⅛" OD liquid line for 40 ft. Near compressor. Silver solder.
7½ hp Condensing Unit in Generator Room in Basement See Detail
GENERAL EQUIPMENT LAYOUT (No Scale)
2½" Connect steam supply and return lines to service within 15 ft.
1¼"
2"
Air Flow
1"
30"x36" Coil
12"x12" Coil
¾"
HEATING COIL DETAIL
To Coil
Heat Exchanger See Detail
⅜" Charging Valve
Run to Open Funnel
Connect to Water Line
⅜"-210# Relief Valve
6" Concrete
1½" Med. Density Mach'y. Cork
COMPRESSOR DETAIL
Strainer
Solenoid Valve
⅛" x ⅞" C'pl'g
2⅝" x 2½" C'pl'g
COOLING COIL DETAIL
Control Valve
12" 24" 12"
Check Valve
Coil Face
Connect to hot water line within 15 ft.
Keep nozzles at least 4 in. from face of coil
SPRAY HUMIDIFIER DETAIL
Liquid to Coils
Liquid from Compressor
Suction to Compressor
HEAT EXCHANGER DETAIL
LEGEND-
A-3⅛" OD x 2⅝" OD Coupling
B-3⅛" OD Pipe
C-3⅛" OD x 1⅛" OD Tee
D-2⅝" OD Coupling
E-3⅛" OD Coupling
F-2⅝" OD Pipe
G-¼" OD Nipple
NOTES-
1-Ream out stops on fittings where necessary
2-Use silver solder on all joints
3-Solder "G" as support for "F"
4-Exchanger Approx. 40 ft Long
AIR CONDITIONING PIPING DETAIL

WHY CALCULATOR IS USED

The first power systems were simple and consisted of a generator and a few lines direct to the loads. Fuses could be used for equipment protection in the case of short circuits. As systems grew larger and more complicated fuses became inadequate and various automatic circuit interrupting devices were developed, mostly known under the general term of circuit breakers. The proper application of these required a knowledge of the magnitude of the current to be expected at the time that they must perform their maximum duty, in other words, during short circuits. Methods were developed for calculating these short circuit currents and the proportion of the current supplied over each line or circuit on the system. The calculations were simplified by neglecting the resistances of the circuits and considering that the current was limited mainly by the reactance of the generators, transformers, lines, etc. The current naturally divided in inverse proportion to the reactance. Considering this, it was not difficult to design an assembly of adjustable resistors which could be connected in any combination, with some means of measuring the current in each resistor. These resistors could then be connected in the same manner as the reactances of the system to be studied and adjusted to have values equivalent to these reactances. With the positive terminal of a direct current source connected to all the resistors representing generators, the negative terminal could be connected to any point on the network at which it was desired to know the short circuit current. The resultant currents in the resistors would be proportional to the total short circuit current as well as the current in every circuit and with proper multipliers would indicate the system current in amperes.

POWER SYSTEMS CONTINUE TO GROW

Power systems continued to grow, and with the growth came additional and more complex problems such as load division and voltage regulation in involved networks and stability between large interconnected generating stations. The proper representation of these conditions in a miniature setup required a representation of the phase angle of the impedance, power source, etc. This demand was finally met about 1929 when some devices were developed using alternating current for power instead of direct current and arranged to represent reactances, resistances, and capacitances as well as the phase angle between the power source. The perfected and modern version of this equipment is known as the Network Calculator.

DATA ASSEMBLED

In the most common use of the equipment complete data on the system to be studied will be assembled, including impedances of all circuits, voltages at various points, power being generated by all generating stations, and the magnitude and power factor of all loads. All of this information is reduced to calculator values. The circuits on the calculator are then connected in the same manner as the generators, lines, transformers, loads, etc., on the power system and adjusted to have equivalent characteristics.

SYSTEM CONDITIONS MATCHED BY CALCULATOR

When all of the known system operating conditions are matched by values on the calculator, which can be read accurately at the meter desk, the entire setup is a correct representation of the power system. The voltages and loads on all circuits of the calculator can be measured accurately, giving information not otherwise readily available because measuring equipment is not usually available at all points on the power system. Changes can then be made, new lines added, new loads served, new generators put into operation, etc., and again accurate measurements can be made at all points to predict the effects of such changes. Transient studies can be made by using a step-by-step process, using the readings of one step to calculate the conditions that must be met on the following step. Less common, but very important to power systems, is the study of transient voltages that last only a cycle or two. These studies are made by reproducing the characteristics of the system on the calculator circuits and repeating the application of the transient rapidly enough by means of commutators so that the voltage wave can be observed on an oscilloscope.

CAN BE USED TO STUDY HEAT FLOW

There are several other uses for the calculator. In some complicated problems of mechanical stresses, heat flow, and acoustics, the elements can be translated into terms of electrical equivalents and the resulting electrical system can be studied on the calculator. The extent of the possibilities in this direction has not yet been fully explored.—*From a talk by Lester B. Le Vesconte, chief engineer in charge of the calculator.*

tem, handling some 3000 cfm of air, serves the laboratory, with the compressor located in a machine room about 300 ft away from the air cooling unit.

Due to the fact that the condensing unit is approximately 300 ft from the cooling coils, and that the cooling coils are approximately 60 ft higher than the condensing unit, considerable pressure drop would occur in the refrigerant lines due not only to the frictional resistance but also to the static head. In order to obviate the possibility of flashing of the liquid refrigerant, an especially designed heat exchanger, approximately 40 ft long, was installed in which the suction line was run inside the liquid line. This deviation from the customary procedure of running the liquid line inside the suction line was arrived at due to the increased efficiency obtained by the added heat transfer surface achieved in constructing the heat exchanger in this manner. In sizing these lines, the piping must be of such diameter that the annular space is of sufficient area for the required flow of liquid refrigerant. Due to the variation in temperatures of the suction and liquid lines and the resultant variation in expansion and contraction, silver solder was used for all joints (see detail on preceding page).

The air conditioned space is divided into two zones, one of them comprising three rooms which have outside exposure and the other a room with no outside exposure. A full heating job is done in winter in the outside exposure zone. The ceiling air diffusers used combine the supply and return in the same unit in the smaller rooms, while separate supply and return ceiling units are used in the large room.

The laboratory is air conditioned primarily for comfort and efficiency of the occupants, as temperature variations in the ordinary ranges do not affect the accuracy of the network calculator. However, cleanliness of the electrical equipment is important, and thus a filtered air supply is desirable. The filter units used are of the replacement type.

Advance Heating and Air Condition Corp. engineered and installed the air conditioning system.

...on Operation, Maintenance, Repair, Alteration, Extension

Operating Engineer Locates Source of Trouble in Refrigeration Piping System

Pictures and Text by
George Holman, Operating Engineer

A MECHANICAL refrigeration system is a closed, hollow circuit in which a highly volatile fluid, called the refrigerant, is circulated by a compressor or pump. Unlike most industrial fluids, a refrigerant is used over and over again. Inside the system which contains it, the refrigerant generally behaves as follows:

I) As a liquid it "expands" into the evaporator through the orifice of an "expansion" valve. The terms "expands" and "expansion," as applied to the refrigerant and valve, are not strictly correct. The valve is really a pressure reducing device designed to keep the boiling temperature of the liquid refrigerant several degrees below the temperature of the room or vessel containing the evaporator.

II) In the evaporator the liquid "unites" with heat which reaches it through the metal walls from air, brine, water or goods and materials to be cooled. This "alloy" of liquid and heat is called vapor, and due to the presence of heat it exerts so-called vapor pressure. This vapor pressure is kept from rising in the confines of the evaporator by permitting the vapor to flow through the return line to the compressor.

III) The compressor serves the dual purpose of maintaining a low vapor pressure in the evaporator and of raising the saturated vapor pressure until its boiling point is above the temperature of the condensing air or condensing water.

IV) Impelled by the compressor, the refrigerant vapor blows with the fury of a tornado through the hot gas line to the condenser. There it loses first its superheat and then its "latent" heat of evaporation to the condensing air or condensing water, and flows by way of the liquid receiver and liquid line back to its starting point at the expansion valve. Here, too, the term "latent," or "resting," is not quite correct. The heat of evaporation is very active in exerting so-called "vapor pressure."

While this general procedure is accepted by engineers and physicists, and supported by physical laws, the refrigerant rarely follows it perfectly in practice. There are many variations, due to a number of causes. Impurities always exist in the refrigerant. The compressor, driven at high speed, always raises the vapor pressure much higher than is necessary to raise the boiling point above the temperature of the condensing water. The condenser is always full of a turbulent mixture of liquid refrigerant, vapor of the refrigerant at saturated temperature, superheated vapor, and often air or other noncondensable gases as well.

Likewise, evaporation may not cease in the evaporator, but may continue along the vapor return line to the compressor manifold and cylinders. Builders of refrigeration equipment safeguard their compressors with safety heads against the dangers of any attempt to compress liquid. However, these devices have their limits. The operating engineer must always be on guard against the return of liquid in the vapor of the refrigerant.

HOW DO YOU locate the source of "flooding" evaporators, "expanding back" of the refrigerant, and "priming" of the compressor in a complex direct expansion refrigeration system? In a step-by-step report in words and pictures, George Holman, operating engineer at a state institution, takes us along on one of his trouble-shooting jobs. You'll find his practical comments of interest and value . . . and *your* comments on this and other operating problems will be welcomed by HPAC's editors. Address Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

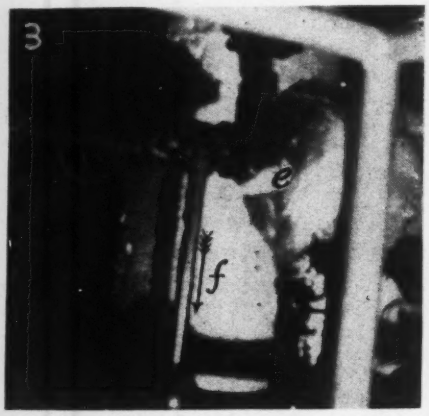
HERE'S STEP-BY-STEP REPORT ON A PIPING PROBLEM

Fig. 1—The compressors of two systems are "frosting up" (*a* and *b*). If frosting is gradual, there is little or no danger. If it is rapid, however, the suction valve should be partly closed, or the compressor shut down, until the source of the flooding is determined and compensating adjustments made. Rapid frosting is generally followed immediately by priming, or pounding of the safety heads. With hand expansion valves, expanding back may take place so rapidly that priming begins before frost has had time to form. In systems where expansion is controlled by thermal valves, priming without frosting is likely only when the compressor is starting up

Fig. 2—The quantity of liquid in the returning vapor is reflected in the temperature of the vapor leaving the compressor, as well as the temperature of the vapor reaching the compressor. If enough liquid is present, it will absorb the heat of compression and evaporate. Here the operator determines the discharge vapor temperature by a thermometer set in a well in the manifold. Since this is an ammonia charged system, his rule of thumb for "wet" compression is that the temperature of the vapor leaving the compressor must not fall below the pressure indicated by the discharge gage. In this case the discharge pressure is approximately 175 psi, as shown on the gage at *d*. Therefore the thermometer in the well at *c* should read 175 F or above

The experienced engineer has many methods of determining the behavior of the refrigerant as it picks up heat in the evaporator and delivers it to the air or water in the condenser. His methods of locating a flooding evaporator in a complex direct expansion system are shown in this series of pictures.

Fig. 3—In his search for the cause of the expanding back, the operator discovers an auxiliary hand expansion valve leaking refrigerant, as shown by frost on the valve body at *e*. This is the source of expanding back of one system, since this valve is used only



in an emergency. Normal flow is through the pipe *f* to automatic expansion controls

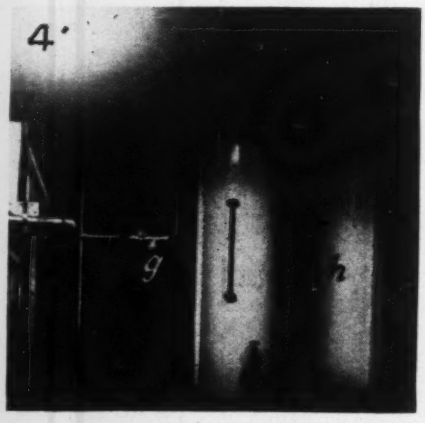
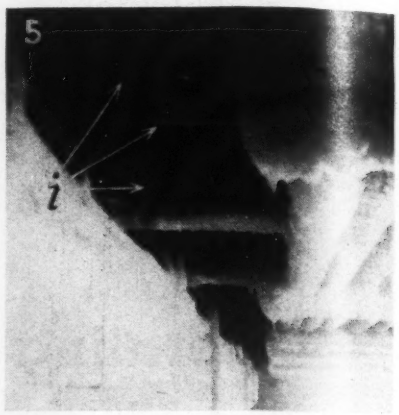


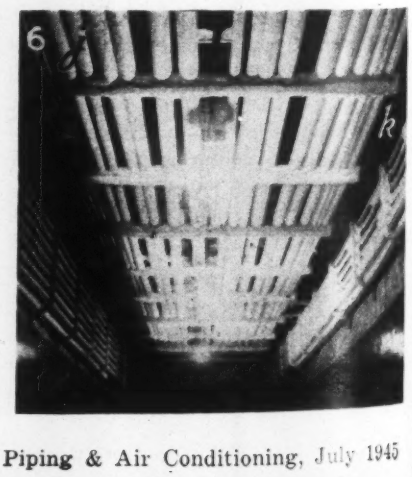
Fig. 4—Frost shows on the liquid line *g* and the indicator of the accumulator at *h*. The high frost line shows that there is enough liquid in the accumulator to prime the compressor when starting. Opening of the magnetic stop valve at the end of the off cycle permits a rush of warm liquid through the accumulator coil. This causes violent ebullition of the low temperature liquid outside the coil, and much of this liquid is thrown into the vapor flowing from the evaporators to the compressor. Vapor from the evaporators is usually somewhat superheated, and evaporates part of the liquid. The



remainder accumulates on the compressor pistons, where more of it evaporates to absorb some of the heat of compression. Being very incompressible, only a very little liquid left in the clearance space will cause the safety heads to lift, with resulting pounding and danger to the compressor.

Fig. 5—A glance into an ice storage shows the experienced operator that three evaporators are not flooding. As shown by the arrows radiating from *i*, all return pipes are bare of frost, or nearly so. This indicates that the vapor leaving these evaporators is superheated

Fig. 6—The operator enters a 30 F storage room containing four evaporators, each of which is fed with a separate thermal expansion valve. At a glance he acquits the left hand ceiling evaporator of flooding, since the last three pipes of the coil are bare of frost, as at *j*, and hence contain superheated vapor. As a partial aside, the operator notes from the right hand wall evaporator that the compressor valves have been leaking during the off cycle, since the frost has been melted and partly fallen off the pipes at *k*. This fact also acquits this evaporator of flooding, since hot vapor from the discharge side of the system could not have leaked back into this particular evaporator if it had been filled with liquid



. . . WORDS AND PICTURES TELL THE STORY

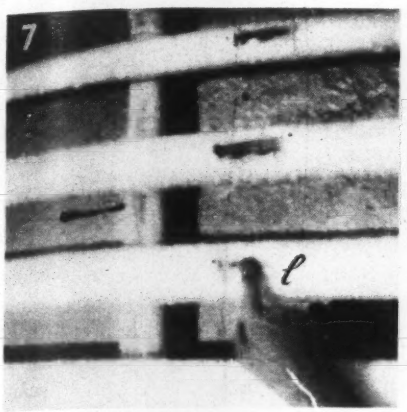


Fig. 7—This leaves two evaporators which could possibly be flooding. As shown by the gage in Fig. 2, the suction pressure is 25 psi. The saturated vapor temperature, or boiling point, at this pressure is about 12 F. Since the "stick test" is generally reliable in higher temperature coolers when the saturation temperature is 15 F or less, the operator cleans off the frost and tests each pipe. His wetted finger tip sticks at *l*, the third pipe from the last. Though frosted, the last two pipes have superheated vapor in them

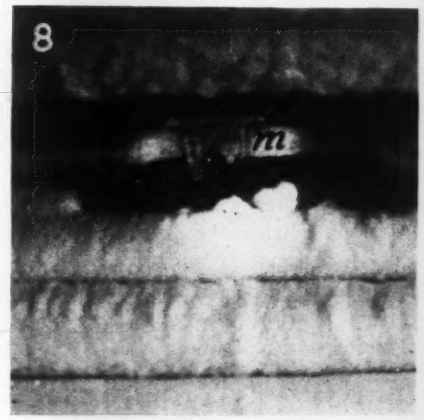


Fig. 8—Here the operator finds a "suspect." The feeler bulb of the thermal expansion valve is frosted over. Vapor leaving through this pipe cannot be highly superheated, and may be saturated or "wet." However, the bulb is making good contact with the pipe, and it is for a bulb making poor contact that the operator is looking. If this is the flooding evaporator, the cause is that the stem of the thermal expansion valve is opened too much, or that the valve is leaking

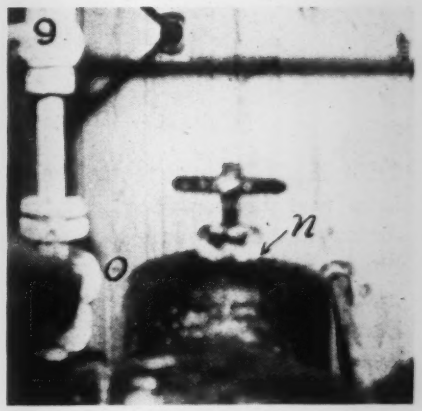


Fig. 9—At the return valve outside the room the operator verifies his suspicions. There is frost on the packing nut, *n*. This may occur anyway, if the valve is in a room well below 30 F, or if very cold vapor at low suction pressure is passing through the valve. The operator determines that this evaporator is the source of the liquid expanding back to the compressor, and that a leaking, or too widely opened, thermal expansion valve at *o* is the cause

Welding Electrode Standard Needed

THE EDITOR—Industry in general, and the welding industry in particular, are and have been greatly handicapped by the lack of a real technical standard covering electrodes. What is needed is a simple, easily understandable standard which would enable a manufacturer to manufacture to it consistently and would enable the purchaser to readily and easily test the electrodes if he wished to do so, to see if the manufacturer was conforming to the standard.

Since there is no need for a weld stronger or better than the material to be welded, I suggest for mild steel, which covers 90 per cent of the requirements, a simple standard, something as follows:

The electrode shall be of such characteristics that it will withstand the following tests to be made any time a buyer might desire:

a) A weld made in ⅜ in. or ½ in. plate of mild steel, planed to the same thickness as the parent metal, must break outside of the weld when pulled in a standard tension machine.*

b) On a section from the same plate mentioned in (a), welds to be bent in any way desired and elongation of 25 per cent in the outside fibers must show no fracture.

It is quite evident that an electrode which will perform as indicated in these two tests will give a weld equal in physical qualities to the plate.

With such a weld, obviously the matter of porosity is of no consequence. However, if it should be desired to cover the question of porosity, a simple test could be made as follows:

A fracture shall be made through the weld. On a straight line through the fractured weld there shall be voids of no more than 5 per cent cumulatively.

There is no question but that an electrode which will withstand the above very simple tests will be satisfactory in welding mild steel.

It seems to me that this is a question to which the filler metal committee of the American Welding Society should give proper attention.—J. F. LINCOLN, president, Lincoln Electric Co.

* * * *

F. W. Dodge Corp. reported recently that construction activity in the 37 states east of the Rocky Mountains showed sharp gains in May. Contracts awarded called for an outlay of $242,523,000, which was 68 per cent more than in May 1944. Total contracts for the first five months of this year amounted to $1,255,101,000, a gain of 57 per cent over the corresponding period of last year.

Uncle Sam

Wants You

to Fight

Waste!

SAVE FUEL

Here's a Summer Maintenance Schedule for Heating Plants

By L. W. Mauger, Supervising Engineer
Brown, Wheelock, Harris, Stevens, Inc.

THIS ISN'T an article on wartime fuel conservation, but a discussion by a man responsible for the operation and maintenance of a large number of heating systems on the routine work that should be done now to protect heating equipment and assure its condition for good results next winter. That proper attention to heating maintenance during the summer months means better efficiency and more satisfaction when the temperature drops, goes without saying. And this year—with many government warnings about a critical fuel situation next winter—every item of maintenance work done now is a patriotic contribution to the war effort, as well as being good engineering, g o o d business

PREPARATION FOR the summer heating plant rejuvenation begins when a cleansing compound is added to the boiler water to cook for a week or two to loosen any sludge or scale from the water side to be blown out when the water is drained. Soda ash or one of the sodium phosphates is often used for this purpose, but if oil is present due to piping changes having been made, something to absorb the oil, such as a little fine fuller's earth, should be added. The boiler should be drained and flushed at the close of the season and refilled to the safety valve with a little protective compound in solution, and allowed to be brought almost to the boiling point to expel the air.

Blowing Down Boilers

An adequate means of blowing down is desirable even for a small heating boiler, so that sludge will pass off with the water. A 1 in. straightway cock or gate valve should be the minimum size, with cocks up to 2 in. for larger low pressure boilers. Where small drain cocks and lines are found, such as a ½ in. faucet for a 100 hp boiler, the sizes should be increased to assure proper blowdown results. The blowdown line should lead directly from the boiler and not be connected from a return line. However, if the boiler drain is not the lowest point in the system, additional drains should be installed at the low points if above the floor level. Porkchop boilers must have some means of draining both sides, preferably independently, so that the maximum rate of water flow may be achieved.

Steel boilers are usually designed to be blown through the returns which are connected at the rear a few inches from the bottom. The water legs, being at a lower level, cannot be fully drained and there is apt to be an accumulation of sludge which may eventually result in boiler failure at these points. This can be overcome by welding blowdown connections to the water legs near the corners. For steel boilers, it is good practice also to remove the handhole and manhole covers and hose out the interior. Rust, scale, or barnacles clinging to the surfaces may be scraped off, and the metal surfaces examined. Excessive scale, rust, or pitting is evidence that the water has not been properly conditioned and arrangements should be made for the necessary treatment. Regular, systematic blowing down during the operating season is an essential part of water treatment. While the boiler is open, submerged hot water heating coils should be examined and cleaned, and their level should be checked to be certain there are no interior pockets for dirt accumulation, and that they are properly supported so as to prevent contact with the boiler tubes. Such a contact may cause holes due to rubbing while expanding and contracting, and it may cause pitting due to galvanic action.

A blowdown line leading to a sump or sewer will be used more readily by the boiler tender than one draining on the floor or boiler pit, unless the floor or pit has a drain connection. A boiler below the sewer level, with no sump available, should be equipped with a small purge pump or siphon to permit the water to be removed. High pressure boilers are customarily provided with blowdown tanks.

The tubes of water tube boilers should be examined by removing some or all of the tube caps and opening the drums. If necessary, scale should be removed by turbining. Scale in tubes reduces heat transfer and may lead to tube failure. All tube caps and manhole plates should be thoroughly scraped and fitted with new gaskets.

Leave Boilers Filled?

There is some difference of opinion as to whether it is preferable to fill steel boilers with water or to leave them empty when not in use. Building operators generally recommend filling them to prevent corrosion on the water side. This leaves the fire side subject to corrosion due to condensation of moisture when the boiler temperature is lower than that of the surrounding air, but this may be counteracted by coating the fire side with light oil if the location is damp, or by absorbing excess moisture with calcium chloride or other such agent.

Although the fire side, gas passes, and tubes must be kept reasonably clean during the operating season, they come in for special care at its close. Suitable brushes and handles should be supplied so that the operating personnel may thoroughly clean all surfaces exposed to the fire and gases, removing all soot, fly ash, and fire scale. No areas should be omitted, such as small

passes at the top of some sectional boilers or back connections of some boilers. The spaces between the tubes of water tube boilers are often difficult to reach except with special brushes or with compressed air. A used garage compressor might prove to be a splendid investment for boiler cleaning. High pressure steam may also be used, but low pressure steam is apt to condense, forming mud on the surfaces. An occasional turbining of fire tube boilers will remove fire scale and loosen water scale which may have formed on the outside of the tube. It will also discover weak or defective tubes which might not otherwise have been found until a leak develops during the winter.

Flues, Breechings, Chimneys

Flues, breechings, and chimneys (including the bases of stacks) require annual removal of excess soot and fly ash. The entire flue system should be checked for leaks and properly sealed. Dampers—including linkages and pulleys—need lubrication. Forced or induced draft blowers and their connecting ducts require cleaning and checking.

Defective grate bars, brickwork, and baffles should be renewed during the summer. Loose doors should be refitted or replaced, and loose or missing insulation reapplied. Valves may be repacked and reground if necessary, diaphragms of regulators renewed, and leaking piping replaced. Boiler return traps, checks, and air eliminators may be cleaned or replaced, and thermostatic elements of radiator and drip traps* tested and renewed

*See Regular Testing of Steam Traps Aids Wartime Heating Efficiency, by L. W. Mauger, in the April HPAC.

ANNUAL HEATING REPORT

BUILDING.....

DATE.....

SUPERINTENDENT.....

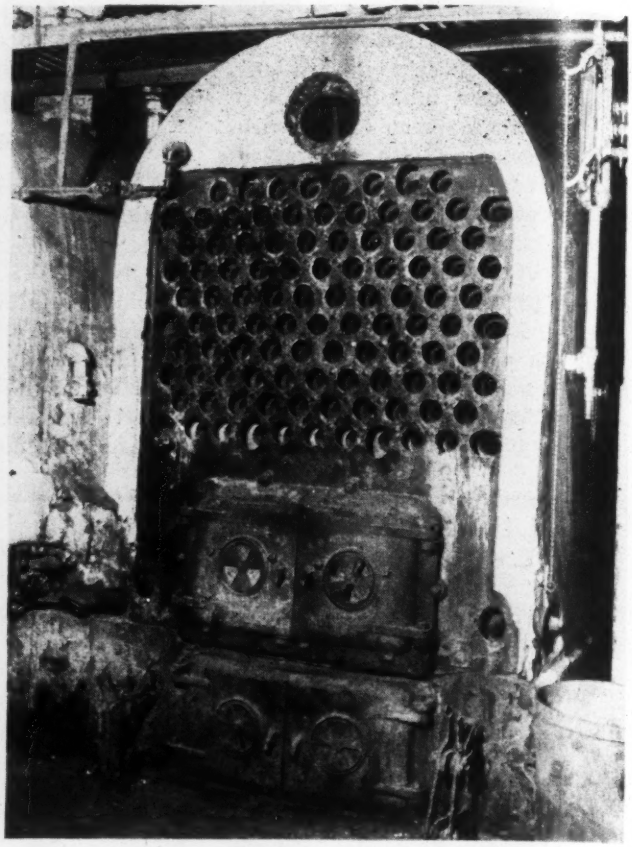
Please answer the following questions where they apply to your building and return this form to the engineering department. Our fuel records and our summer repair schedule depend on the *prompt* reply from *all* buildings, and your cooperation is definitely required to eliminate delays and the necessity for additional reminders. Due to priorities and limited supplies, delays may prevent delivery of materials in time to complete repairs. The duplicate copy may be kept at the building.

1. What percentage was your building occupied during the past heating season? ....%
   What percentage was your building occupied during the previous season? ....%
2. Is hot water supplied? .... How is it heated?.... (by individual steam boiler, hot water heater, submerged coils, steam coils in storage tank, etc.)
3. How many *heating* boilers are there in your building? .... They were manufactured by the ....Co. and are of the water tube ( ), fire tube ( ), sectional ( ) type. (Check type of boiler.)
4. (a) What type heating system do you have? One pipe ( ), two pipe gravity ( ), vapor ( ), vacuum ( ), hot water ( ), warm air ( ).
   (b) What type heat control do you have? (Time clock, thermostat, etc.) ....Manufactured by ....
5. (a) How long does it take to heat all radiators completely? ....
   (b) Are any radiators slow to heat? ....
6. What pressure is required to secure full circulation of steam? ....
7. What improvements in equipment or operation were made since last May?
8. The total consumption of coal during last June, July, August, and September was .... tons of .... size coal.
9. From last October 1 to last May 31 .... tons of .... size coal were burned for heat and .... tons of .... size coal were burned for hot water.
10. As of last May 31, how many tons of various sizes of coal are on hand and how many more tons of various sizes do you have room for? (A ton occupies about 35 cu ft.)

	Size of coal	On hand	Room for
Hot water coal....	———	———tons now	———tons more
Steam coal in bin.	———	———tons now	———tons more
Steam coal in other space	———	———tons now	———tons more

11. From last October 1 to last May 31 .... gal of No. .... oil was used. The *total* consumption for last June, July, August, and September was .... gal of No. .... oil.
12. (a) If oil burners are out of service, have they been cleaned, greased and protected? .... How are they protected? ....
    (b) Have oil heaters been drained of oil and cleaned? ....
13. (a) How far does the water level drop when pressure is raised? ....
    (b) Does all condensation return to the boiler (s) when pressure is dropped? ....
    (c) Does boiler water level fluctuate rapidly when boiler is steaming? ....
14. Are your boilers equipped with low water cutoff? ....
15. Do you need any grate bars? .... How many? ....
16. Are any repairs necessary to the boiler fire brick lining or brick setting? .... To what extent? .... Do you need a contractor for this work? ....
17. If your boilers are steel, have you manually cleaned the inside (water side) by removing man- and handhole plates, flushing mud drums, etc.? .... If "no," do you need a contractor for this flushing? ....
18. Have the tubes, heating surfaces, etc., of the boiler (s) been properly cleaned? .... On what date? ....
    If not, do you need a contractor for this cleaning? ....
19. Have the smoke pipes and connections been thoroughly cleaned? .... On what date? .... If "no," do you need a contractor for this cleaning? ....
20. How many tubes are leaking or plugged?
21. Have you any suggestions for improving the operating efficiency of the heating system? (traps, valves, etc.) Explain:
22. Do you have exposed boiler fronts, doors, hot water heaters or tanks, steam pipes, flanges, valves, etc., that should be covered? .... Explain:
23. Is there any heating equipment in your building (such as boilers, blowers, radiators, dampers, vacuum pumps, etc.) which is not being used and could be removed? ....

List ——————— Condition———————



Maintenance attention paid to heating plants now will save fuel and money next winter. Tube caps and manhole plates should be thoroughly scraped and fitted with new gaskets. If necessary, scale in tubes of water boilers should be removed by turbining, as scale reduces heat transfer and may lead to tube failure. The rear view, above left, of a locomotive type boiler shows the tubes being punched with a steel wire brush. At the right is a low pressure water tube boiler with the tube caps and the upper and lower handhole plates removed for cleaning and inspection. . . . Save fuel!

where necessary. Vacuum pumps can be tested with the inlet valves closed to ascertain if sufficient vacuum can be pulled and maintained.

Oil burners should receive close attention during the summer. In addition to the general cleaning, the burners, strainers, and blowers need carbon, sludge, and dirt removed. Oil heaters may need deposits dissolved by circulating a solvent. Fuel oil storage tanks having excessive sludge or water may be pumped out, although the use of solvents in the oil should minimize sludge. Refractories, arches, and checker floors usually need some repair or replacements. Sometimes the use of a smaller nozzle for generating hot water in the summer will improve efficiency. Low water cutoff and automatic water feed devices should be tested. King and return valves should be closed and aquastats set as low as possible.

Don't Neglect the Piping

An attempt may be made to eliminate circulation difficulties which have caused knocking or lack of heat in any areas. Repitching of lines, renewing valves, replacing missing radiators, and correcting poorly designed enclosures will pay dividends in occupant satisfaction and will equalize heating—eliminating the necessity of overheating some sections in an attempt to supply steam to others. Repacking of expansion joints of the slip type, and examining those of the bellows type, may prevent annoying leaks during the winter.

Hot water heaters and tanks ought to be blown down and, if possible, opened for examination and cleaning. Dirt is responsible for the failure of many water heaters.

In the management of a large number of buildings it has been found advantageous to prepare a questionnaire to be filled in by the superintendents of the various properties for use as a basis for determining the fuel consumption and efficiency of the plant, as well as for making necessary repairs and improvements. A questionnaire which has been found useful is reproduced herewith (see the preceding page).

"Open for Discussion"

AIR CONDITIONING RESULTS DEPEND ON GOOD DESIGN

THE EDITOR—O. W. Ott, consulting mechanical engineer, brings up a couple of good points in his article on pages 194 and 195 of the April issue. Most of the criticisms of existing air conditioning systems seem to be due to the lack of respect the owner, the architect, the consulting engineer, and even the air conditioning contractor have for the problems of true air conditioning. There has been entirely too much feeling that this is an old story, simply a development of the old heating and ventilating industry, and if we are honest with ourselves we will admit that the old heating and ventilating industry was pretty terrible in some respects.

Specifically, I would question Mr. Ott's statement that "We as engineers have failed to profit by the fundamental lessons learned 20 to 30 years ago in air circulation and distribution, etc." I have not seen any work 20 or 30 years old, or done during the intervening period, which would indicate to me that the engineers of the old days understood any fundamental lessons on the subject of handling air. Rather it seems that as long as air was too hot that was considered a good heating system, and as long as there was enough air blowing around to be sure you could see it or feel it, that was good ventilation. What it produced within the region of the workers was very, very secondary.

The air conditioning engineer would like to think in terms only of the refinement of temperature and humidity control, but if we are to work on the broader problems we can't help but recognize the heating and ventilating problems. Schoolhouse ventilating has never been called air conditioning, and neither do we call factory heating systems or industrial fume removal systems air conditioning, and yet they are heating and ventilating and they are certainly entitled to the same respect that we give to air conditioning.

Franchised Dealers

I would also question Mr. Ott's paragraph that "Where franchised dealers are competing direct for a given job, conditions are still worse in this respect." I speak from the other side of the fence as a franchise dealer, and by and large it seems to me that the franchise dealer has to spend most of his time educating the customer and the architect and the consulting engineer up to the standards required for a good job. He is constantly faced with the driving power of these professional men and the owner to keep the cost down. On given competition he may be told how little somebody else is willing to take for the job.

The franchise dealer is pitted against other franchise dealers in the name of trade benefits, big name advertising, etc., and it takes a lot of courage for him to refuse to sell a good name product on an improperly designed job. If he thinks the other fellow will take the responsibility he will sell the product. In fact, many manufacturers are offering good name products to anybody who will put them in and undertake no supervision whatever of the quality of the work that is done by the contractor or the engineer.

I have been told that the postwar trend will be away from franchise dealers on the part of the manufacturers, and that they will expect the architects and engineers to properly design their buildings and systems and be able to specify the right size of equipment and purchase it and it will function properly, just like the lath and plaster do in the walls. This I doubt. It is the franchise dealer who lives with the customer through the growing pains and his adolescent period of his first use of the building, who stays with him from season to season, who is there in future years to take care of extensions and alterations and to work out the refinements which were omitted in the name of economy in the first installation.

I agree heartily with Mr. Ott that there is no substitute for careful analysis of conditions, and that whoever designs the job must keep in mind that the persons involved in a conditioned space will expect perfection, and nothing less than that will satisfy.—LESTER T. AVERY president, Avery Engineering Co.

WHEN ENGINEERS gather to hear a paper or talk, there comes a time when the meeting is thrown "open for discussion." We follow this custom in these columns, which provide an opportunity for readers to comment and discuss articles published in HPAC and other topics of interest to heating, piping, and air conditioning engineers and contractors. The editors will welcome your remarks. Address Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Illinois.

ENORMOUS CONSTRUCTION VOLUME NEEDED

Construction programs that have been announced by private enterprise and provided for by the federal government, "which now total approximately $21,000,000,000," give an indication of the enormous amount of construction that will be needed after the war, H. E. Foreman, managing director of the Associated General Contractors of America, declared recently in discussing the outlook for the industry.

"Private construction programs that have been publicly announced total about $6,000,000,000 and the public programs about $15,000,000,000," he explained. "Most of these programs cover periods of from five to 10 years."

Official U. S. Marine Corps photo

HEATING AND AIR CONDITIONING FOR WAR PRODUCTION DISCUSSED

Consulting, Contracting, and Research Experiences

AT A WAR production conference held earlier this year at the Stevens hotel under the auspices of the members of the Chicago Technical Societies Council, the Illinois chapter of the American Society of Heating and Ventilating Engineers sponsored a panel session on heating and air conditioning. The program for this session comprised talks on wartime experiences in consulting engineering, wartime experiences in contracting, and wartime experiences in research. A question and answer period, in which members of the audience participated, followed the presentation of the three prepared discussions.

WARTIME EXPERIENCES IN CONSULTING ENGINEERING

Samuel R. Lewis, consulting mechanical engineer and member of HPAC's board of consulting and contributing editors, gave the following resumé of his experiences in wartime consulting engineering:

I WISH that instead of talking about things I have helped design while safely bending over a drawing board, I could be telling of real experiences on the battle front.

This has been an engineers' war and so I have been kept very much more effectively employed during World War II than during World War I. My work has involved manufacturing plants and Army and Navy training plants and housing for the people who work in war plants. It has run the gamut from ventilating poison-gas-proof underground radar centers to ventilating canvas mess tents in which chow is prepared. We have learned something from designing cities, with high and grade schools, churches, stores, hospitals and laundries all out of whole cloth, for war workers.

An interesting plant for making airplane propellers is entirely detached, out in the country. It was built during a time of great stress to conserve ferrous materials and combined heating and process piping was insisted on. Also, 50 psi had to be the minimum steam pressure. We will change this pressure after the war, since it is so difficult to vent properly the air from a 50 psi heating line, and as a result corrosion commenced to

manifest itself within months.

The owner wanted to install two very large water tube boilers, with elaborate air preheaters, economizers, and instruments for indicating and recording the input and output. This equipment was refused by Washington and six 300 hp fire tube boilers with underfeed stokers and minimum instruments were allowed. It is worth noting that experience with these simplified boilers and stokers has been exceedingly favorable.

Another case involved a refrigerated blackout plant making a precision machine product. Over 5000 tons of refrigeration was installed —chilled water is employed to absorb the heat in summer. The same water is warmed to furnish heat in winter. Partial recirculation of the air is permissible in some departments under automatic temperature controls but heat treating furnaces of great size require year around heat removal. This heat removal was accomplished successfully by partially enclosing the furnaces and arranging for an independent supply of air directly from out-of-doors to carry away the surplus heat, thus economizing on refrigeration. Adequate heat exhaust from the forging shop also was accomplished by using outside air for supply.

This plant employs live steam in considerable quantities for testing turbines. There is no practicable way to recover the heat from this exhaust steam, so that it escapes to the atmosphere. Occasionally, when the wind is in the right direction, this steam drifts across the building for hundreds of feet and enters the intakes of the ventilating system, where it condenses and has been known to overtax the drainage facilities at the overhead air supply fans.

In another war production machine shop, blackout construction was specified, but during the progress of development Washington refused to sanction use of refrigeration. A blackout machine shop without refrigerated cooling and with a tremendous electric power and illumination load becomes unlivably warm in August unless profuse ventilation is provided. To alleviate this situation we had to install mechanical ventilation to the extent of about 4 cfm per sq ft of floor. An extra cost for ventilation and building structures to enclose the fans of around $250,000 was required.

Experience with blackout plants using refrigeration has uniformly been favorable during the war. I know of corporations who are building or who plan to build shops without windows or skylights but having controlled year around temperature. Sunlight is hot, it changes constantly, varies widely and does not compare in efficiency with modern electric illumination. Windows and skylights get broken, cost heavily for washing, and if unwashed soon become opaque.

Oil Mist in Machine Shops

We have experienced much difficulty during the war with oil mist in the air of machine shops. It drips from beams and lamps. It isn't nice in lungs or on one's body. It is possible, at considerable expense, for air ducts and power to carry away some of this mist. The ducts, however, become loaded with oil and are a fire hazard even if the oil does not drip from every joint. I have seen pools or ponds of oil, inches deep, on machine shop roofs near the exhaust fan outlets.

We undertook research to overcome this mist problem. The sources at the machines can be hooded much as one hoods a woodworking machine to carry away the shavings in an air stream. It is economical and desirable to return the large volume of air to the room so as to avoid replacing it with heated or refrigerated air. It is desirable to return the cutting compound to the reservoir of the individual machine.

It is practicable to evaluate and record the proportion of oil mist in the air by photography. We had a black box, about as big as a coffin, through which the exhaust fan could discharge the mist-laden air. An intense electric light beam within the black box showed the oil particles, just as one sees dust particles in the air in a brilliant light beam. We tried various impingement filters, baffles, etc., and ultimately tried an electrostatic precipitator. As a result of this research the precipitator was installed, and the oil mist problem was solved, with very material savings in operating cost and with much improved health conditions.

Corrosion of Piping

During the war there seems to have developed an unusual amount of corrosion of ferrous piping, due to the presence of noncondensable gases and water under pressure and heat.

There is increasing realization that carbon dioxide under such conditions can dissolve not only steel piping but also malleable iron castings. Analysis of the water alone, removed from a corroding pipe system does not always disclose the damaging medium, which may have been lost into the air between the hot piping and the cool laboratory. We have found serious damage to the steam process piping in a war plant while live steam was injected to heat the acid liquid of open tanks or baths into which metal parts are dipped as for degreasing, descaling or preparatory to surface treatment. It is possible, where such injecting is done, for occasional conditions to occur when subatmospheric pressure exists in the steam piping, so that the contaminated bath liquid is drawn into the steam piping and eventually damages this piping seriously. It appears that in such locations a dependable vacuum breaker should be installed to perform the same function served by the vacuum breaker on the water supply pipe to a flush valve water closet.

WARTIME EXPERIENCES IN CONTRACTING

Following is an abstract of the remarks of W. S. Bodinus, Carrier Corp., on wartime problems in air conditioning and refrigeration contracting:

AIR CONDITIONING and refrigeration continue to be major factors in the war program. In the first stage of the defense program, it became necessary to air condition many precision manufacturing

spaces as well as to furnish and install special testing rooms, cabinets, and refrigeration equipment to simulate actual field conditions. The original ordnance program for the manufacturing of explosives, gun powders, and timing fuses demanded quite extensive air conditioning equipment and installation.

The manufacturing facilities for refrigeration and air conditioning equipment have been taxed to the limit to provide standardized equipment for the armed forces in the form of refrigerating units, freezer boxes, equipment on board ship, advance base depots, for food storage as well as actual field installation of mobile and portable units for both refrigeration and air conditioning. Most of this equipment is of the self-contained type, designed for instant operation by plugging in a power line or by being driven by small gas engines.

At the present time greater precision-made weapons are in the making. Parts must be measured to the 10,000th part of an inch and a variation of a few degrees in temperature will cause many of the metals to change their dimensions. Precision mass production is thus impossible without controlled temperatures and humidities, since components are made in plants all over the country. Such precision items as fuel injectors, carburetor parts, gages, instruments, and lenses are impractical to manufacture without controlled temperatures and humidities.

Rocket Powder Requires A.C.

Field experience in the handling and using of explosives from the arctics to the tropics, from the surface of the earth to the stratosphere, and in temperatures above 180 F and below minus 50 F have created new problems which are being eliminated one by one. The development of rocket powder is a most unusual and extensive program where air conditioning is being employed in the drying of the basic explosive from its mush or slush condition and dehydrating to a moisture content of a fraction of a per cent. It is further processed by high pressure rolling into sheets which naturally causes a rise in temperature to nearly the ignition point, and blast cooling must be applied to keep it under control. Extruding, forming, and other processes similarly are carried out in air conditioned spaces with many departments with intricate and special air conditioning all because of the careful geometric design of each little particle of this explosive.

Just as important as temperature is the maintenance of humidity at a very dry condition to prevent reabsorption of the moisture, and field experience has proved that air conditioning must not stop even with the finished product because unusual weather conditions encountered in the jungles have caused all sorts of unforeseen conditions which have distorted many of the calculations. Retarders and inhibitors, as well as special coatings, are applied in special atmospheres and the application of these coatings and the drying of them requires not only proper temperatures and humidities but needs adequate ventilation to eliminate toxic nitroglycerine and other vapors from seriously affecting the workers.

Completed pellets, tubes, and other forms are tested at various conditions from 50 F below zero to 200 F above and rigid standards are employed from the very start of production. A certain percentage of each day's production is tested for the purposes intended and variations are reduced to a very narrow degree.

The air conditioning and refrigerating systems and contracting required for this work are so extensive as to parallel any past domestic or war activity in the history of air conditioning. These tremendous programs, however, are rapidly being concluded and more and more of these destructive rockets are being delivered to our soldiers and sailors to get it over quickly.

Peacetime Implications

Not all of this effort, however, goes up in smoke, since new principles of fabrication and erection are being created by this work all the time and are certain to affect peacetime installations of air conditioning. The handling and distribution of air over critical products of this type will result in new and better systems of air distribution for comfort cooling. Maintenance of temperature and humidity controlled constantly at close limits and through broad ranges (heretofore believed impractical) is now becoming a standardized arrangement. The pumping of air through tubes and conduits and the use of air pressures far beyond that ever attempted before in air conditioning systems, is bound to lead to more compact, more efficient, and better design of air duct systems for commercial application.

One wartime program of comfort air conditioning is under way in hospitals, where in some instances complete hospitals are being air conditioned to shorten the time of rehabilitation. Health is regained rapidly in conditions of comfort and quiet. In the sanitariums it is hoped that by air conditioning certain departments the shellshocked and mentally unstable can be further comforted and more quickly cured. In these programs the high pressure conduit air distribution system with individual room control is most desirable so proper air conditions for each patient can be had.

WARTIME RESEARCH IN HEATING AND AIR CONDITIONING

Cyril Tasker, director of research of the American Society of Heating and Ventilating Engineers, discussed wartime research in heating and air conditioning, and the prewar pioneering of the society in this field. Following is an abstract of his remarks:

WARTIME RESEARCH for the ASHVE began in May 1939 when the laboratory was asked to undertake investigations for the air conditioning section, design division, bureau of ships, U. S. Navy. Among the earlier studies were those dealing with cyclic temperature changes in a ship structure due to sun radiation; the humidification of living quarters and the air volume requirements for ready rooms on air-

craft carriers; and the spot cooling of workers in engine and fire rooms.

Some of these studies, begun in the research laboratory, were later transferred to naval vessels, and several studies were made on ships at sea. To facilitate this work, the director of the laboratory, Dr. Ferry C. Houghten, was commissioned a lieutenant-commander in the Naval Reserve. He was later called to active duty, served for almost three years with the bureau of ships and the bureau of medicine and surgery, and died recently while still on active duty.

Effect of Noise on Man

Several of the studies were made in the psychrometric rooms of the society, which were among the earliest rooms to be designed and used on this continent for the study of man's response to his environmental conditions. In them the society carried out the work which resulted in the development of the "lines of effective temperature," and it will be of great interest to learn how much use has been made of the "effective temperature scale" by our armed services and those of our allies. Much of the research work on the effects of environmental conditions on man which has been carried out by the armed services of the United Nations has as its basis the pioneer work of the ASHVE.

It will perhaps be interesting to you to know that the society was also asked to make studies on noise measurement and the physiological and psychological effects of noise on man. After critically reviewing over 100 references on this subject, the society undertook a study to determine the relations existing between the temperature of the environmental air, the noise level in the space, and the accuracy, variability and volume of work of young men representative as to age and physical characteristics of Navy personnel. In these studies the society obtained the cooperation of two outstanding psychologists, Dr. Viteles of the University of Pennsylvania and Dr. Kinsley Smith of Pennsylvania State College. Definite correlation was found between the environmental conditions and the volume and quality of the work performed.

A study was also made to determine the effect of branch take-off design on noise in ventilating duct systems. Large differences in noise intensity in the branch take-off were observed, depending upon the design and setting of the splitter.

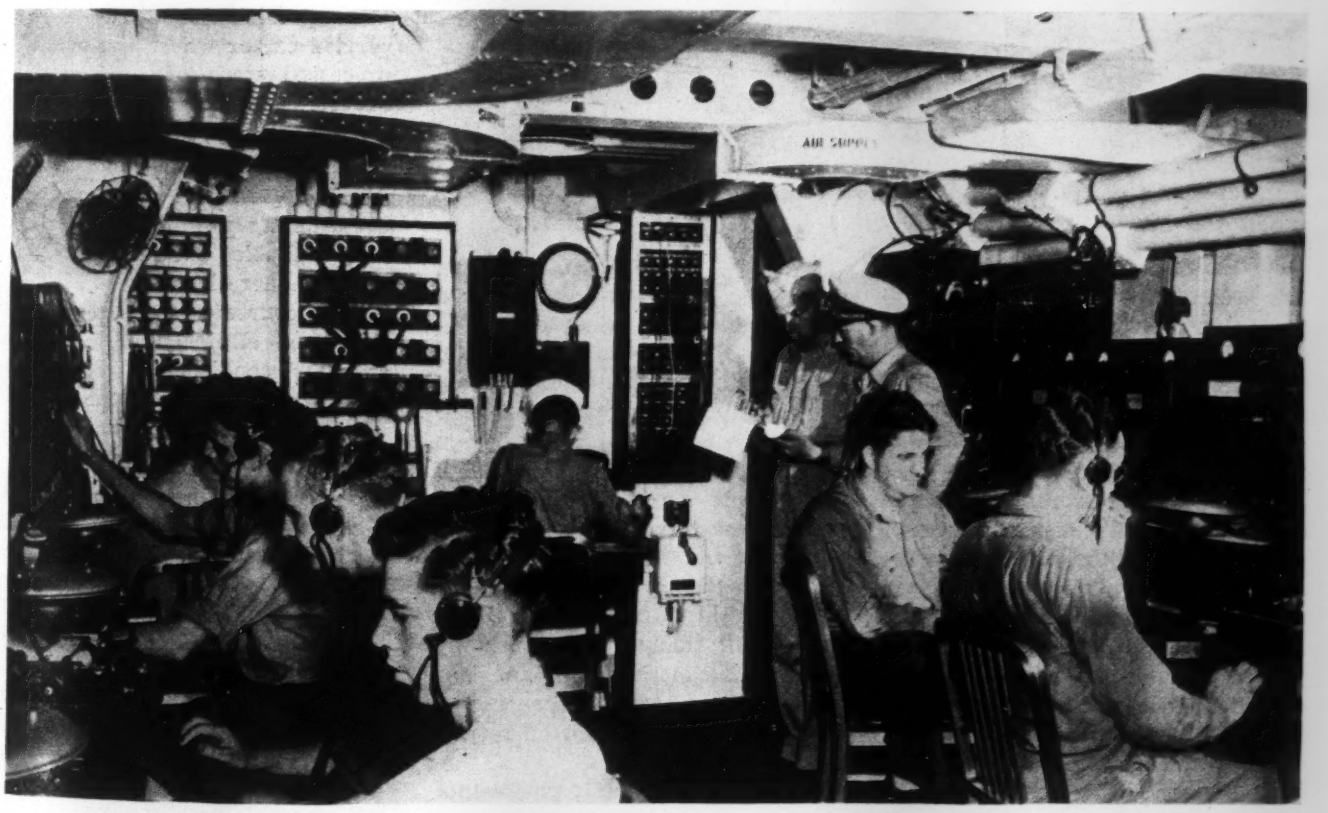
Hot Environments

Between August 1939 and March 1943 the laboratory carried out an extensive series of tests to determine the physiological reactions of men exposed for four hours to hot atmospheres and surrounded by hot surfaces. Tests were made at effective temperatures as high as 95 deg and with mean radiant temperatures up to 40 deg above the dry bulb temperature of the air. The tests served to confirm that all variables in a man's environment which affect his physiological reactions may be expressed in terms of effective temperature and mean radiant temperature elevation. Since naval ships are likely to move from temperate to tropical zones in a relatively short space of time, these findings had important bearings on the selection of design conditions.

Just as soon as the Navy Department can release the results of these studies for the benefit of air conditioning engineers, we shall make them known to you. They

Much research on air conditioning was done for the Navy

Official U. S. Navy photo



will, I think, have an important influence in postwar developments in industrial air conditioning.

The naval medical research institute, the Army air force's laboratory at Wright Field, and the Armored medical research laboratory at Fort Knox have all made studies on the effects of clothing and other factors on man's physiological response to his environment under conditions of rapidly changing temperature and altitude and under conditions of stress. An important conference was held a few months ago under the auspices of the office of the Quartermaster General to discuss the principles of environmental stress on soldiers. Air conditioning engineers present stressed the importance of wartime research in these problems of global warfare.

The bureau of ships has studied the performance of all types of heating, ventilating, and air conditioning equipment under conditions far more stringent than would ever be met on land and has developed simplified and efficient designs for various pieces of equipment. The practical results of all this research are daily before our eyes in the magnificent performance by the ships of the United States Navy in the waters which Japan only a little while ago thought were its own.

Control of Airborne Infection

Without air conditioning and without research into the atmospheric conditions necessary to process blood and store blood plasma and to make penicillin in vast quantities, our casualty lists would make more sorrowful reading. Recent research on the subject of air sterilization and the control of airborne infection by the use of glycol vapors distributed in minute concentrations throughout an enclosed space have not only found immediate application in military establishments, but give promise that by control of airborne diseases, respiratory infections will be materially reduced in the not too distant future.

Much of the research work in heating, in air conditioning, and in noise control carried out during the war will of necessity have to remain on the restricted list for some time to come. We shall all hope that for reasons too numerous to mention, this period will not be any longer than absolutely essential.

LIVELY DISCUSSION PERIOD FOLLOWS THE THREE TALKS

Following the presentation of the three talks on wartime experiences in consulting engineering, in contracting, and in research, a lively discussion period in which members of the audience participated was held. Following are excerpts from this session:

A PLANT engineer brought up the question of whether central or unitary air conditioning equipment should be used in factories. This provoked a lively discussion. In reply, Mr. Lewis said that in his office now they were trying to use separate compressors, separate fans, separate coils, separate filters, etc., because "the factory-made units just don't allow enough space for necessary maintenance work." Another consulting engineer said that he would like very much to use factory-assembled units and felt that they weren't satisfactory now for the same reasons as outlined by Mr. Lewis—that is, they just weren't made so that you could get at them to do necessary maintenance. However, he felt that the air conditioning industry could take a tip from automotive and aviation engineering and design lines of unit equipment which would be so arranged that despite their compactness, necessary maintenance could be done. He said also that the air conditioning industry ought to have "some better refrigerant than it does now," by which he meant a refrigerant that would require less than one horsepower to produce a ton of refrigerating effect.

As to central vs. unit type equipment, Mr. Bodinus said that you couldn't beat the central type of air conditioning system from the standpoint of cost, results obtained, and life of the equipment, in his opinion.

Another plant engineer, referring to the article published in the January 1945 issue of HPAC by R. D. Tutt and his associates, asked if it had been definitely proved that factories should be air conditioned. There was quite a bit of discussion on this point. Mr. Lewis said that they should, and that in addition, all illumination should be artificial. He backed up his statement with experiences in various war plants and said that those that depended on natural lighting had very poor illumination because some days were sunny and some were cloudy. Also, it is impossible to get labor to keep skylights and windows clean. As further proof, he mentioned a large manufacturer who operates an air conditioned Defense Plant Corp. factory. They are now designing a new factory of their own which will not be a DPC job and this factory they are building with their own money will be air conditioned.

A member of the audience mentioned that there was no question of the need for air conditioning where precision manufacturing was carried on, or where the materials processed were of a hygroscopic nature.

A prominent heating and air conditioning contractor said that there was no question of the need for air conditioning with the present and the probable future high wage rates. Where labor costs are high, it is of course essential that manufacturing efficiency be increased and air conditioning to provide comfort for the workers is one method of increasing manufacturing efficiency, he said.

Along the same lines, Mr. Bodinus said that an industrial air conditioning system can be owned and operated for 2 to 3c per man-hour and that when this cost is compared with high hourly wage rates, there is no question of the value of increasing the workers' efficiency and therefore the overall manufacturing efficiency of a plant by means of air conditioning.

Sam Lewis' Page

CENTRALLY HEATED PUBLIC HOUSING PROJECTS

IN THIS regular feature, informal comment on heating, piping, and air conditioning problems is given by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors.

LARGE, CENTRALLY heated public housing projects are receiving wide attention. Almost every conceivable method has been tried out—from stoves, to furnaces, to direct steam radiators, to hot water convectors, to indirect steam heated warm air. In all of them, great pressure has been brought to reduce the initial cost—frequently with little regard to operating cost and with little consideration to the comfort of the occupants.

The judgment of the architect and the engineer frequently is overruled by economic expediency. To this end, one may cite elimination of basements through which the service pipes conventionally were installed in prewar buildings and the elimination of attic spaces above the top stories, with their well known resistance to transmission of solar heat in summer.

Floors on Ground

Masonry floors are laid on the ground, even though bare feet are not usually happy when applied to such floors. Dry walls and dry floors admittedly are desirable, and footing drains admittedly contribute to dry walls and floors—but even the footing drains tend to be omitted in many of these projects. Rooms so shallow in height that a reasonably tall man can touch the ceiling are encouraged, even though we all find comfort in fairly lofty rooms.

In the light of these structural tendencies, the following are a few of the expedients that are evolving on the part of the engineer to meet the constricted structural problems:

A project covering many large buildings and occupying about four square city blocks is heated from a coal burning central station. The site is level. The buildings vary from rows of duplicate two story dwellings separated each from the other by party walls, to three story apartment homes, each a "flat". There are three stoker-fired steel boilers, with pumped hot water flowing through them under pneumatic pressure maintained in the expansion tank.

This arrangement, using the same water over and over, greatly reduces the maintenance on the boilers, since there is no recurring accumulation of sediment and scale and no necessity exists for water treatment to reduce internal corrosion.

There is a further advantage in that the water temperature is adjustable to meet weather variations and thus, being less hot during mild weather, it works for economy by preventing too many open windows.

There is another very decided gain fuel-wise, in that the water temperature in the boilers is much cooler during most of the hours when heating is necessary than during the coldest hours. There is therefore, a maximum temperature difference between the fire-heated surfaces in the boilers and the water-cooled surfaces, permitting improved transmission of heat and reduced temperature of chimney gases.

In the community house where there are relatively large rooms, radiant heating from hot water pipes imbedded in an assuredly dry fill under the masonry floor is provided, and throughout all apartment rooms on the ground story level at least one-third of the masonry floor area alongside the outer walls is of radiant type warmed by the various service pipes.

Laundry on Roof

There is a laundry in each building for use of the tenants. Instead of placing the laundry in a poorly lighted, difficult-to-ventilate basement, the laundry is on the roof, with sunlight on all sides, with ample windows, and opportunity for the tenants to use the flat roof for sunlight clothes drying.

Domestic hot water is heated by steam in a storage tank having a removable, cleanable, U-tube heater, and this steam is generated locally by automatically controlled gas heaters. Thus the underground heating services need not be kept hot in summer. It is easy to remove scale from a removable steam heated domestic hot water heater.

"THE DAMNED HEATING BUSINESS"

Field Marshal Karl von Rundstedt, German army commander, had heating problems on his mind in August 1942, in addition to all his other troubles. Writing to his wife on August 6 of that year, he said, "I am worried about your food and now the damned heating business will start soon, too," reports John M. Mecklin of the Chicago Sun foreign service, in giving a series of excerpts from von Rundstedt's letters which presumably fell into the U. S. Army's hands when the field marshal was captured.

August—or before—is the right time to worry about next winter's heating, for it is during the summer months that something can be done about it. Is your heating plant in the best condition for efficiency in the use of fuel and for satisfactory results? Have you ordered your coal or oil? Is your building in shape to prevent waste of heat? Do you have the proper heating controls?

Fewer Colds in Air Conditioned Places, Doctor's Analysis Shows

THERE ARE fewer colds in air conditioned plants, with the incidence of colds higher in drafty places, according to a two-year study conducted by Joseph H. Kler, M.D., of New Brunswick, N. J.

Dr. Kler's report, appearing in the June issue of Archives of Otolaryngology, published by the American Medical Association, covers basic and detailed facts about the occurrence of the common cold in industry which, he said, is responsible for more than one-third of the total number of days lost in American factories. Colds cause a loss of 100 million working days each year with the annual cost running up to two billion dollars.

Dr. Kler said he undertook his study in order to appraise the cold situation in industry as a general problem rather than as a disease problem. "In other words," he stated, "I wanted to approach this as a production problem and study it objectively." Reports and tabulations were made week by week during the entire two years.

Assisting in the survey was Dr. H. L. Daiell, of the Johnson & Johnson research foundation, who organized and supervised the procurement of data among the employees of the various Johnson & Johnson plants located in the east and midwest.

Dr. Kler's study disclosed that:

Time-losing colds in air conditioned places are below average except in the summer months. The shipping departments uniformly have a high general incidence of colds and a high incidence of time-losing colds. These departments usually are drafty. In each plant certain departments consistently have a high incidence of colds. Although these departments were not studied completely, most of them had some factor of ventilation that was not up to the average. Dr. Kler points out that figures on ventilation might be misleading because of the in and out movements of the occupants from one type of atmosphere to another.

There is a definite pattern to the incidence of colds, with the highest peak in December and the lowest in July.

There is a definite correlation between temperature and the onset of colds, every sudden drop in temperature being followed in a day or two by a rise in the number of colds. Recordings of humidity were instituted late in the study, and not enough data were secured to determine correlations or express an opinion.

The highest incidence of colds was found in the age group 20 to 29 years and the lowest in the age group above 50 years. However, the percentage of time-losing colds increased with age—17.2 per cent in the group who were under 20 years to 26.8 per cent in the group who were 50 years of age and over.

There were more colds among women than among men.

There were consistently more colds among office employees than among factory workers.

More colds start on Monday than on any other day of the week, this being especially true of colds among men.

Posture is an important factor, with the incidence and severity of colds lowest among those whose work necessitates walking about most of the time.

Smoking apparently has little effect on colds.

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TWO TYPES OF PIPE LINES USED IN ENGLISH CHANNEL

"Operation Pluto," the submarine pipe line system which carried gasoline across the English channel to Allied armies in France, was aided by U. S. Army engineers through the procurement by the North Atlantic division of 140 miles of cable-type pipe. Four American manufacturers produced the special pipe for the engineers under highly secret conditions. A second type of pipe made wholly in England was also used to assure the success of the project.

The cable pipe line produced in the United States is of similar construction to the protective cover which houses the famous trans-Atlantic cable. It is composed of a hollow lead pipe without a core, heavily reinforced with wire and provided with a special waterproof covering. The cable type pipe was laid from the holds of cable-laying ships.

Because of the numerous hazards anticipated in laying the pipe line across the treacherous channel, another pipe line composed of 20 ft lengths of 3 in. diameter steel pipe was developed by the British.* This pipe could be welded automatically into any length and could be wound onto a drum-like thread on a spool. The welded steel pipe, though smaller, is similar to the submarine pipe line used by American Army engineers to unload tankers in ship-to-shore operations. To use this pipe, huge floating drums were developed, capable of carrying the full length of pipe which might be required for the channel crossing, and which could be towed by tugs, like a large bobbin playing off the pipe as it went. The 40 ft diameter and approximately 120 ft circumference of the drum was sufficient to permit the coiling of the semi-rigid steel pipe.

The initial plans drawn up by British engineers for the submarine pipe line system were approved in 1942 by the Petroleum Branch, Office, Chief of Engineers, as being a practical engineering approach. —*News release from the bureau of public relations, War Department.*

*See page 330, June HPAC

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When Is Complete Air Conditioning of the Modern Factory Advisable?

By H. A. Mosher, Mechanical Engineer
Kodak Park Works, Eastman Kodak Co.

CAREFUL RESEARCH work, which has been in progress for a period of over 20 years at the American Society of Heating and Ventilating Engineers' laboratory and in other locations, has made it possible to predict accurately the response from a comfort standpoint of individuals to various levels of effective air temperature(1, 2, 3).* The material which follows is actually a summation of several reports on this research program, one of the best of which is entitled Air Conditioning in Industry, by W. L. Fleisher, A. E. Stacey, Jr., F. C. Houghten, and M. B. Ferderber (13).

IN ANSWERING the question, When Is Complete Air Conditioning of the Modern Factory Advisable?, in his article last month, Mr. Mosher compared the results obtained with air conditioning and with an "ideally designed ventilation system." For those who wish to judge the validity of the conditions he used in his comparison for factory areas served by ventilation systems, and the air volumes required, he presents here the reasoning which lies behind his analysis. This material is actually a summation of numerous research reports and gives a quick picture of some of the data available on the effect of air conditions on people. . . . Mr. Mosher concludes that, in a climate such as that of Rochester, N. Y., it is impractical with ventilation to provide inside effective temperatures below about 72.5 deg under average entering air conditions. This figure is comparable to that obtained in the past at about 10 air changes per hour, he says, with low lighting levels. With the present trend toward greatly increased lighting levels in industrial buildings, it would be necessary—with straight ventilation—to increase air volumes to as high as 32 changes per hour for equal comfort. With such a high required ventilation rate, complete air conditioning will often be found to be the economic and practical answer

Maximum Effective Temperature

For the present, let us confine our attention to Curve A in Fig. 1, representing the recommended maximum permissible effective temperatures† at various degrees of physical activity of the individual.

In deriving the data in Curve A, observations were made of certain physiological responses when subjects were exposed to extreme effective temperatures. Included among these physiological responses were such items as the following:

a) Increase in body temperature (rectal).
b) Increase in pulse rate.
c) Increase in leucocyte, or white blood cell, count.
d) Increase in systolic blood pressure.
e) Decrease in diastolic blood pressure.
f) Decrease in vital capacity (lungs).
g) Decrease in weight.

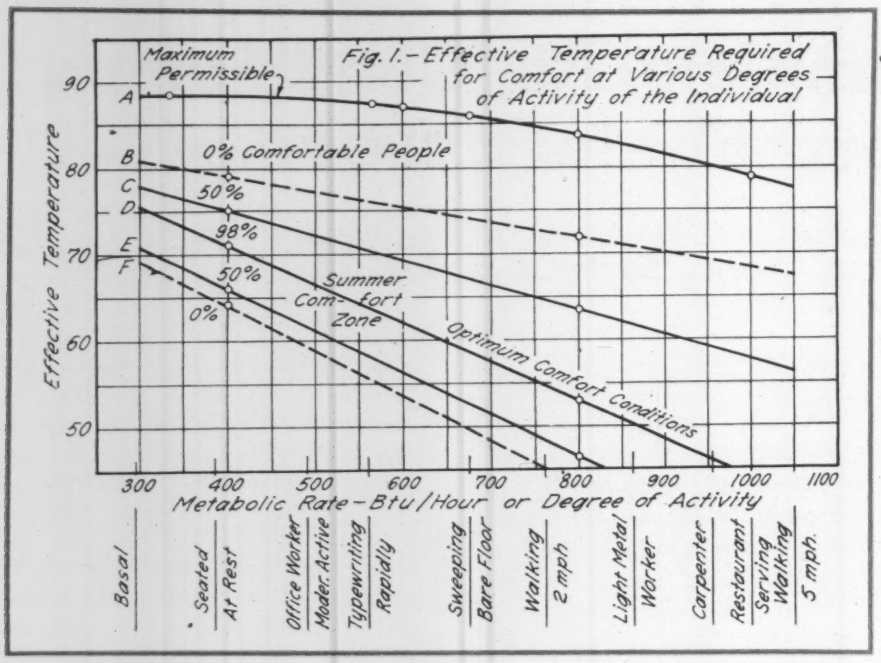
In determining such a maximum permissible level of effective temperature, it is obviously not possible to obtain data under any condition which is permanently harmful to the subjects. The actual maximum permissible effective temperature shown in Curve A therefore represents only the medical opinion of qualified doctors (M. D.'s) consulting with the experimenters. The curve is actually based on allowing a maximum rise in body temperature of 1.5 F after exposure of the subject 3 hr at the given effective temperature. It was observed that rise in body temperature and increase in pulse rate were always a positive index of exposure to hot conditions, and that the other undesirable physiological effects usually accompanied these two. The 1.5 F increase in body temperature, for example, was accompanied by a 34 beats per minute increase in pulse rate, and 8.2 per cent decrease in vital capacity, and a 15 oz per hr reduction in weight.

It is difficult for the non-medically trained person to judge properly the importance of not permitting effective temperatures to exceed those shown in Curve A. Avoiding the additional burden on the heart, as indicated by the changes in systolic and diastolic blood pressures, certainly seems a worthwhile aim. Also, there is some evidence (13) that repeated artificially induced body fever can result in reduced ability of the blood stream to produce the increase in leucocytes, or white blood cells, which is important in the body's defense against infections. Considering also that this maximum allowable effective temperature is based on qualified medical opinion, it does not seem to be an undue limitation to place upon ventilation and air conditioning system performance.

As will be shown in later determinations of resulting effective air temperatures inside ventilated spaces, this maximum permissible

*Numbers in parentheses refer to bibliography at end of article.

†Effective temperature is defined by the ASHVE's Heating, Ventilating, Air Conditioning Guide as: "An arbitrary index which combines into a single value the effect of temperature, humidity, and movement of air on the degree of warmth or cold felt by the human body. *The numerical value is that of the temperature of still, saturated air which would induce an identical sensation of warmth.*" [Italics added.]



effective temperature shown in Curve A will actually be exceeded on the hottest summer days in modern buildings ventilated by old "rule-of-thumb" methods. Any reasonably well designed air conditioning system will, of course, provide conditions well below those shown in Curve A.

Referring now to the lower group of curves in Fig. 1, the values plotted at a metabolic rate of 400 Btu per hr have been widely published in the ASHVE's Heating, Ventilating, Air Conditioning Guide and elsewhere. The second group of values at the 800 Btu per hr metabolic rate are taken principally from the paper entitled Heat and Moisture Losses for Men at Work, and Applications to Air Conditioning Problems, by F. C. Houghten, W. W. Teague, W. E. Miller, and W. P. Yant (9). No attempt will be made to defend showing the conditions between these two values as a straight line function, since this information is used here only in a qualitative way. Actual comfort and cost comparisons were made in last month's article only at approximately the 420 Btu per hr level of metabolic rate.

In Fig. 1, Line D, labeled Optimum Comfort Conditions, shows the values of effective temperature at which approximately 98 per cent of subjects would feel comfortable when engaged in various degrees of physical activity. Thus, when seated and leisurely talking at a desk (metabolic rate of 400 Btu per hr), approximately 98 per cent of people would be comfortable at an air condition of 71 deg effective temperature. This might be, for example, 78 dry bulb at 37 per cent relative humidity in relatively still air. An active office worker, however, would require an effective temperature of about 67 deg for optimum comfort, which might correspond to about 73 F dry bulb at 37 per cent relative humidity in relatively still air.

It should be noted also that the range of effective temperatures at which 50 per cent or more of moderately active office workers would be comfortable is approximately 11 deg, different people, of course, being included in the group feeling comfortable at either extreme of this range.

From the above, it can be seen that there is no optimum effective temperature for all conditions of physical activity, but that for any given degree of physical activity the optimum air conditions can be set with reasonable accuracy.

Best Possible Comfort Conditions With Ventilation

The question next arises as to what are the best possible comfort conditions which can practically be obtained with an ideally designed ventilation system, and in this connection Fig. 2 has been prepared. This shows the effective temperature which would result in a certain floor area of 28,000 sq ft, when circulating air volumes varying from 0 to 60 changes of the entire room volume each hour. This resulting effective temperature, of course, depends on factors other than the volume of air circulated, such as the temperature and humidity of the air being drawn from the outside and the rate of generation of heat inside the space by the occupancy (body heat, lights, machinery, etc.). Accordingly, the graph contains two families of three curves each, the three curves in each family representing rates of internally generated heat (H_1) of 10, 20, and 30 Btu per hr per sq ft of floor area. The upper group, or family, of curves is based on outside air at the average maximum condition for Rochester, N. Y., or 93 F dry bulb and 54 per cent relative humidity. The lower family of curves represents the condition of outside air at the average summer, daytime conditions in Rochester. Since these conditions would be equalled or exceeded for more than half the summer daytime working hours, it follows that the actual resulting effective temperature in a space would be higher, and hence less comfortable, than those shown for slightly more than half the normal summer daytime working hours, and lower than those shown during the remainder of the time.

The three levels of internally generated heat were arrived at by actual calculation of the probable loads on three floors of a proposed new building. The resulting values of H_1 were 9.4, 21.3, and 27.3 Btu per hr per sq ft.

For convenience, dotted lines indicating several comfort conditions, taken from Fig. 1 at about 420 Btu per hr metabolic rate, have been superimposed on Fig. 2.

Reference to Fig. 2 will show that the minimum allowable number of air changes, even at the lightest internal loads, will be about four per hour in order to avoid exceeding the maximum permissible effective temperature on the worst summer days. At the highest level of internal loading the same limitation would require about 17 changes per hour minimum.

In considering the average entering air conditions, it will be seen that increasing the number of air

changes above about 30 per hour does not provide appreciable improvement. Also, it should be noted that at previously conventional air volumes of eight to 10 air changes per hour, the resulting inside conditions at an average internal loading of $H_1 = 20$ will provide comfort for only about 40 per cent of the occupants for less than half the summer daytime hours. At a maximum internal loading of $H_1 = 30$, everyone will be uncomfortable for over half the summer daytime hours.

Larger Ventilation Air Volumes Now Required

From this analysis, it would seem that larger ventilation air volumes than those conventionally installed in the past are required. The basic reason for this increased requirement is not increased standards of comfort, but rather a marked increase (two to three times) in the intensity of factory lighting, and hence in the internal heat load. In other words, $H_1 = 10$ was probably the maximum internal heat loading prior to the inception of the current trend toward higher lighting intensities, and 10 air changes per hour would be reasonably satisfactory for this condition.

If 10 air changes per hour be accepted as producing sufficient comfort at $H_1 = 10$, the resulting effective temperature at average entering air conditions is 72.5 deg. Under this condition, approximately 75 per cent of the occupants should be comfortable about half the summer daytime hours, and on the worst outside days the maximum permissible effective temperature would not be exceeded. This seems a reasonable goal to set for comfort in ventilation systems, and the required air volumes for other levels of internal heat gain can accordingly be determined—namely, 20 changes per hour at $H_1 = 20$, and 32 air changes per hour at $H_1 = 30$.

Summarizing, then, it is impractical with ventilation, in a climate such as that of Rochester, N. Y., to provide inside effective temperatures below about 72.5 deg under average entering air conditions. This figure is comparable to that obtained in the past at about 10 air changes per hour, with low lighting levels. With the present trend toward greatly increased lighting levels in industrial buildings, it is necessary to increase air volumes to as high as 32 changes per hour for equal comfort.

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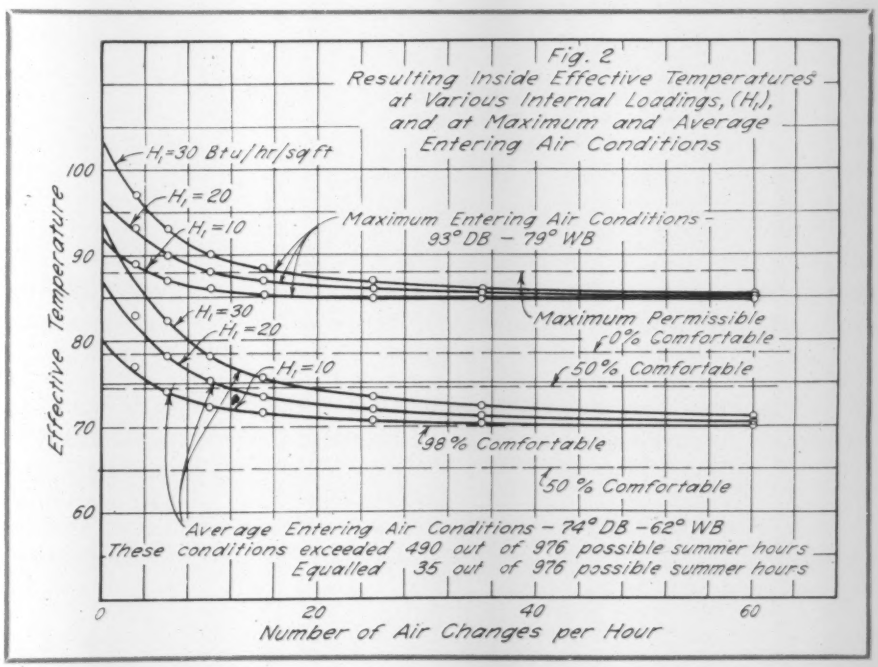

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There is no optimum effective temperature for all conditions of physical activity, but for any given degree of physical activity the optimum air conditions can be set with reasonable accuracy

Trend Toward Increased Lighting Load

*16) American Recommended Practice of Industrial Lighting, approved March 17, 1942, by American Standards Association.

Fuel Oil Ration Order Amended

Following is information on amendments to the OPA's fuel oil rationing order Rev. RO 11, issued since publication of the June issue:

AMENDMENT 59, EFFECTIVE JUNE 29

1. *Present regulations.* In zones A-2, B-2, and C-2, a consumer using residual oil for heat or hot water or both, is entitled to a ration for his full normal requirements instead of two-thirds of normal requirements as in the case of the users of other grades of fuel oil.

Proposed change and reasons for change. Sharply reduced supplies make it necessary again to curtail the issuance of rations for residual oil. Rations for users of residual oil will be issued on the basis of two-thirds of normal requirements or of base period consumption. Such users will again be permitted to apply for additional rations if they meet the tests of hardship as now set forth in the regulations.

II. *Present regulations.* A fuel oil dealer without registered storage capacity, for whose account fuel oil is delivered to his customer by another dealer or primary supplier, may collect the evidences for the transfer only as the agent of the deliverer and must surrender the evidences to the deliverer.

Proposed change and reason for change. This change will clarify the regulations so as to permit the dealer to exchange his customer's check for a board check. If he does so he must endorse the board check and surrender it to the deliverer.

AMENDMENT 60, EFFECTIVE JULY 2

Fuel oil rations may no longer be issued for the production of paving products or dust palliatives or for surfacing or maintaining roads. This action, as well as the provision made May 8, 1945 for the issuance of rations and use of slow curing road oils for these purposes, was taken at the request of the PAW. It conforms with PAW's recent action in prohibiting the manufacture of road oil and its use as a paving material or for laying dust. The ban is being restored by PAW and OPA because the present short supply of residual oil does not warrant processing oil for these purposes.

The PAW action was taken by formally amending directive 72, which formerly banned the use of road oil only in the west coast states—Oregon, Washington, California, Nevada, and Arizona. The directive extends the restriction to all other states and the District of Columbia.

Round-up on Construction Supplies Forecasts Probable Improvement

In issuing a round-up of the current supply situation for construction materials last month, WPB said progressive improvement in future months is probable but warned that it will take time "to fill the pipe lines."

The outlook for materials of particular interest to HPAC's readers is as follows:

Cast iron soil pipe is in extremely short supply with little stock available, orders heavy and increasing rapidly, and no relief in sight. Cast iron pressure pipe is in a somewhat better position, although orders are heavy and increasing and no improvement is foreseen. Concrete pipe, on the other hand, is readily available from stock or new production. Structural insulation board is in fair supply, but subject to delay in deliveries. Cement asbestos pipe is available with only small delay in filling orders. Orders for clay sewer pipe exceed production, and much of present stock is obsolete. Stocks of most items of heating equipment are limited, WPB says, and many are subject to long delivery delay.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Comparative Quantitative Studies of Bacteria in Air of Enclosed Places†

Part I of Air Pollution Survey Report

By Leon Buchbinder,* Mathilde Solowey** and Morris Solotorovsky***

From Department of Health, New York City

SUMMARY—Approximately 5,000 samples of air in schools, subway cars, theaters, streets and in a park were taken during a period of one year to determine quantitatively the total bacterial flora. The samples were taken on plain and blood agar in about equal numbers.

It was found that schools, which were studied most intensively, had on the average more organisms per cubic foot of air than any of the other types of location studied. The other places studied can be arranged according to a decreasing order of magnitude of the bacterial counts as follows: Subway cars, non-air conditioned theaters, streets, air conditioned theaters, and the park. The differences in counts between the several types of locations are largely a matter of variation in dust and bacteria associated with dust, occupancy and ventilation.

The schools, as a group, showed a greater amount of variation between individual schools sampled than did any of the other types of location. These differences, in part at least, could be ascribed to variability in their original construction. Variations in the counts, moreover, were found in each of the schools according to whether a room was a classroom or an assembly room, or occupied or vacant.

When the subway car findings were divided arbitrarily into two groups, one high and one low in the number of persons present in the cars at the time of sampling, they showed differences which were fairly consistent throughout the year. The total bacterial count in subway cars also varied according to the hour of the day in which samples were taken. Here, too, the differences seemed to be a measure of occupancy, both present and recent.

A correlation in schools between the total bacterial counts and the alpha hemolytic streptococcus counts, previously reported, is indicated and the suggestion is made that the total bacterial count may be used as an indirect index of nasopharyngeal contamination of such places.

THIS PAPER presents a portion of the data collected during a survey of normal bacterial flora in the air of enclosed places which was conducted in New York City in 1936 and 1937.

When this survey was made there was almost no conclusive evidence for the broad principle that the microbial flora of places where people live or congregate are significant in the transmission of respiratory infections. Since then much research on this subject has been conducted and the principle of air borne spread of disease is now fairly generally accepted (3). In fact one of the most active fields of study in the prevention of respiratory infections today is that concerned with procedures for the removal by sanitary means of pathogenic microorganisms from room air, floors, bed clothes and the like. Some of these techniques are of immediate concern to the ventilating engineer (4).

The purpose of the survey in New York City was twofold: First, to obtain a composite picture of the bacterial flora of the air by total counts in places of assembly such as schools, theaters and subway cars, in which would be depicted broadly the variations, if any, induced by population density, ventilation, season, time of day and meteorological conditions; Second, to determine, as was first suggested by Gordon (5), and later reiterated by Wells (6), whether a specific microorganism, the alpha hemolytic streptococcus which is a normal inhabitant of the human throat could be found in the air of these places and in such numbers as to be correlated with the persons present, their activity and the physical status of the premises.

The data concerning this second purpose have already been pub-

†The first of a series of four abridged reports of the N.Y.C. Air Pollution Survey conducted by the New York City Department of Health, Ernest L. Stebbins, Commissioner, under the supervision of Sol Pincus, Deputy Commissioner and Sanitary Engineer. The bacteriological studies reported here were conducted in conjunction with the De Lamar Institute of Public Health, College of Physicians and Surgeons, Columbia University, Earle B. Phelps, Professor Emeritus of Sanitary Science.

*Senior Bacteriologist, Sanitary, Dept. of Health, New York City.

**Associate Bacteriologist, U. S. Department of Agriculture, Eastern Regional Research Laboratory, Chestnut Hill Station, Philadelphia, Pa.

***Major, Sanitary Corps, A.U.S.

lished elsewhere (1) and the pertinent findings in that report may be briefly summarized. Alpha hemolytic streptococci, the large majority of which seemed to be of nasopharyngeal origin, were found to be distributed in the air of enclosed places, although in small numbers compared to the other bacterial flora. These streptococci were found to be present most frequently and in greatest numbers in the air of school buildings. An apparent relationship was noted between the status of the school room studied and the number of alpha hemolytic streptococci found. Thus occupied assembly and occupied classrooms had a greater number of these organisms than did vacant rooms. It should be pointed out, however, that although the above study indicated that alpha hemolytic streptococci of the air may be used as an index of human habitation their presence denotes past as well as present occupancy. This was suggested by, for example, the effect of floor sweeping on the general bacterial flora, data on which are presented here, and was clearly implied in laboratory studies later carried out by the authors on the survival of alpha hemolytic streptococci in simulated room environments under varying physical conditions, particularly with reference to daylight and sunlight (4, 7). It was also noted that the average number of alpha hemolytic streptococci per cubic foot of air found in the six schools studied was greatest in antiquated, crowded and dirty schools and least in the more modern, cleaner schools which had large windows and high ceilings.

A study was also made of the presence, in these normal environments of man, of beta hemolytic streptococci, the pathogenic microorganisms which cause septic sore throat, scarlet fever, erysipelas, puerperal fever and the like, and which are shed into the air from the human nasopharynx in a manner similar to that for the nonpathogenic alpha hemolytic streptococci (2). These organisms of the pathogenic type, as was to be expected, were present much less frequently than were the alpha hemolytic streptococci which are much more universal inhabitants of the normal human nasopharynx. One of the significant findings in the report was that by those laboratory tests available for the determination of potential pathogenicity these strains of beta hemolytic streptococci, isolated from normal places of habitation, could not be distinguished from an equivalent number of similar strains directly isolated from patients suffering from streptococci disease. Only some 52 strains of air borne beta hemolytic streptococci were isolated as compared with 1947 alpha hemolytic streptococci isolated during the course of the study[1]. Thus one organism of the potentially pathogenic type (beta) was found for approximately every forty of the non-pathogenic type (alpha). This finding brings to mind a conclusion recently drawn regarding the long established coliform index for drinking water, namely that in a good water supply for every million non-disease producting colon bacilli one or more enteric pathogens (typhoid or paratyphoid bacilli) may be present (9).

The following data on the total bacterial count reveal a close parallelism to those on alpha hemolytic streptococci previously mentioned. Thus, if a yardstick for bacterial air pollution of the types of internal environment studied here is desired as a guide to sanitary ventilation, the total bacterial count on agar without reference to any particular type of microorganism might serve as well as the count of alpha hemolytic streptococci. The former has the advantage of being more readily and accurately determined.

Collection of Samples

Samples were obtained in a routine manner by means of the Wells' air centrifuge at the several types of locations, and studied for total bacterial count (10). Samples were taken from six public schools twice weekly for a period of approximately 12 months. Similarly, samples were collected in subway cars while in use from two to five times a week, and both air conditioned and non-air conditioned theaters were studied before, during, and after performances. In conjunction with the school studies, the air of adjacent streets was also examined.

Bacteriology

All media were freshly prepared from raw material. The basic medium was chopped beef infusion agar adjusted to a final pH of 7.6 to 7.8 Each batch was tested by implantation of cultures for its ability to grow alpha hemolytic streptococci. Citrated sheep's blood was added to the basic medium to make blood medium.

The Wells' centrifuge tubes were prepared in the laboratory by pouring 20 to 25 cc of beef infusion 2.2 per cent agar, at approximately 47 C into sterile centrifuge tubes which were then spun for four minutes in a Wells' machine with the air inlet tube closed. The spinning caused the agar to solidify into a thin, even coat. After spinning, the tubes were closed with a sterile rubber stopper the center core of which had been replaced by a plug of cotton, and were incubated overnight at 37 C (98.7 F). The following day, after discarding any contaminated ones, the tubes were sent out into the field. To make blood-agar 5 to 7 drops of citrated sheep's blood were added per tube before spinning.

The procedure for sampling was as follows: The stopper was removed with sterile precautions from a plain agar tube which was inserted into the machine and run for 10 min. The manometer was read at intervals of one minute and the mean volume of air sampled was approximately 10 cu ft. Simultaneously wet-and dry-bulb temperature readings were taken and other pertinent meteorological data were obtained. At the end of the run the tube was removed, restoppered, and replaced in its carrying kit. A blood-agar cylinder was then run to complete the first set of tubes. The day's run of a field crew usually consisted of four sets of tubes. The tubes were returned to the laboratory where they received serial numbers and were then placed in an incubator at 37 C (98.7 F).

The following morning the tubes were removed from the incubator and a total bacterial count made of

[1]Walter and Hucker (1942) (8) isolated beta hemolytic streptococci from the floor dust of normal places of congregation.

each. This was accomplished by inserting the tube into a celluloid semi-cylinder mounted horizontally on a solid base. The celluloid was ruled off in squares of one centimeter and was of the same diameter as the centrifuge tube. An electric bulb beneath the cylinder furnished illumination for the tube during counts. Counting was facilitated by using a tally counter and by dividing the area of the bottle into four segments of approximately equal dimensions. Both blood and plain bottles were counted in this way[2].

Results

Introduction

There seems to be little question that bacteria in the air of enclosed places where people congregate are of two kinds; those which are largely saprophytic in nature and eventuate from the dirt and dust of the environment, and those which are expelled from the upper respiratory tract of the inhabitants and include among their number in addition to the alpha hemolytic streptococci the common pathogenic types. It likewise seems clear that as a rule the major portion of bacteria isolated from such air comes from the dust, and that only a relatively small portion comes from the human upper respiratory tract. These parasitic bacteria include both freshly expelled organisms and others which, having settled out on floor or other surfaces, are resuspended by human activity. The limited data available in the literature make it difficult, except under certain specific circumstances (12), to come to any conclusion as to the relative proportion of these two groups in the air at any given moment. Indeed, it is extremely likely that the proportion of each varies not only from one place to another, but also from hour to hour in a single location. Additional knowledge is required to determine the proper sanitary measures to eliminate these bacteria from wherever they may be in the environment.

It should be stated before the findings are discussed that the blood agar medium used measures the presence of what might be called the true dust or saprophytic bacteria and those respiratory bacteria resuspended from dust as well as those very recently projected into the environment for the first time. On the other hand, as is pointed out under the sub-head Findings the main flora grown on plain agar are the true dust bacteria and but few respiratory bacteria are found. Thus, part of the difference between the numbers of bacteria on these two media represents the greatest proportion of human respiratory organisms isolated from the air.

Findings

The findings for the mean numbers of bacteria per cubic foot of air of some 5,000 samples, about equally divided between plain agar and blood agar, which were collected in the several types of locations are given in Table 1. About 46 per cent of the samples were taken in schools, about 20 per cent in the subway, and the remainder were divided among the other types of locations studied.

It is seen that schools yielded the highest number of bacteria, both on blood agar and plain agar, and that in descending order follow the findings in subways, non-air conditioned theaters, streets, air conditioned theaters and in the park. It is also noteworthy that in each type of location the number of organisms found on blood agar exceed those found on plain agar. As stated in the section on collection of sample technique, each batch of plain agar was tested before use for its ability to grow alpha hemolytic streptococci, and it was believed that the plain agar would

Table 1—Mean Total Bacteria and Alpha Hemolytic Streptococci for Various Locations

	Mean Number of All Bacteria Per Cubic Foot of Air for Each Type of Location Studied						Mean Number of Alpha Hemolytic Streptococci Per Cubic Foot of Air in Schools and Subway Cars (Positive Samples Only)	
	Blood Agar		Plain Agar		Blood Agar and Plain Agar		—Blood Agar—	
Location	No. of Samples	Count Per Cu Ft	No. of Samples	Count Per Cu Ft	No. of Samples	Count Per Cu Ft	No. of Samples	Count Per Cu Ft
Schools	1,161	27.1	1,159	20.5	2,320	23.8	1,164	0.22
Subway	491	17.7	496	11.9	987	14.8	491	0.15
Non-Air Conditioned Theaters	130	12.8	135	8.4	265	10.6	....	...
Air Conditioned Theaters	314	3.1	323	1.9	637	2.5	....	...
Streets	282	10.1	291	7.8	573	8.9	....	...
Central Park	124	3.0	128	1.9	252	2.4	....	...

Table 2—Total Counts of Bacteria at Each Samplying Station at Each Type of Location.

	Mean Number of All Bacteria Per Cubic Foot of Air for Individual Stations at Each Type of Location						Mean Number of Alpha Hemolytic Streptococci Per Cubic Foot of Air for Each of Six Schools (Positive Samples Only)	
	Blood Agar		Plain Agar		Blood Agar and Plain Agar		—Blood Agar—	
Location	No. of Samples	Count Per Cu Ft	No. of Samples	Count Per Cu Ft	No. of Samples	Count Per Cu Ft	No. of Samples	Count Per Cu Ft
Schools 1	180	39.0	183	30.8	363	34.8	180	0.32
2	192	39.7	295	32.0	488	35.9	194	0.21
3	186	26.4	185	19.9	371	23.1	186	0.22
4	211	21.4	204	17.6	415	19.6	209	0.19
5	197	20.6	211	13.3	408	16.9	199	0.16
6	194	17.0	181	10.0	375	13.7	196	0.16
8th Ave. Subway	491	17.7	496	11.9	987	14.8	....	...
Non-Air Conditioned Theaters 1	48	16.9	52	9.4	100	13.0	....	...
2	56	10.5	58	7.8	114	9.2	....	...
3	26	10.3	25	7.7	51	9.0	....	...
Air-Cond. Theaters 1	142	2.4	145	1.1	287	1.7	....	...
2	107	3.3	127	2.2	234	2.7	....	...
3	65	4.5	52	3.1	117	3.9	....	...
Streets 1	47	15.2	45	9.8	92	12.6	....	...
2	58	12.6	61	8.9	119	10.7	....	...
3	38	7.7	38	6.3	76	7.0	....	...
4	48	7.3	47	4.8	95	6.1	....	...
5	51	7.4	56	9.4	107	8.5	....	...
6	40	8.9	44	6.8	84	7.8	....	...
Central Park	124	3.0	128	1.9	252	2.4	....	...

[2]Dr. Moses L. Isaacs, Yeshiva College, designed and built the counting instrument described.

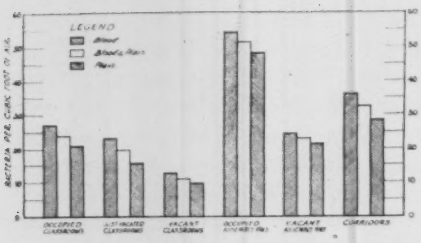

Fig. 1—Average number of bacteria per cubic foot of air by six conditions at all schools for one year

grow alpha hemolytic streptococci as readily as would the blood agar. However, when four pairs of plain and blood agar bottles from schools were selected at random and equivalent numbers of colonies were picked from each bottle and examined microscopically and culturally, it was found that the blood agar bottles of the samples chosen had about 10 per cent of streptococci, whereas the plain agar ones had only about 1 per cent. While this finding does not completely explain the consistent difference in counts between blood and plain agar bottles at all locations, it does indicate one possible reason for it.

Comparison in the table of the total count findings in schools and the subway with those previously reported by the authors for the alpha hemolytic streptococci in the same locations is of special interest. It would appear that in both types of location a relation between the former and the latter exists in the general ratio of approximately 100 to 1.

The total counts for each individual sampling station at each type of location are presented in Table 2. It is noted that, except for schools, the individual stations for each type of location fall into a fairly circumscribed range. Schools, however, show a wide variation with a maximum range of almost 300 per cent. This will be discussed below when the findings at each school are broken down according to the type of room sampled. A matter of interest in this table as in Table 1 is the comparison of the total bacterial count in schools with the alpha hemolytic streptococcus count obtained in the same places. It is seen that the two types of count run roughly parallel and that each of the six schools falls into the same numerical position by either test.

Schools

Several types of room, occupied or unoccupied, were studied as follows: occupied classrooms, just vacated classrooms, vacated classrooms, corridors, occupied assembly rooms and unoccupied assembly rooms. The results for each condition at the individual schools and at all schools are given in Table 3 and Figs. 1 and 2. It is seen from these that at all schools the number of bacteria per cubic foot of air is highest in occupied assembly rooms, followed by corridors and occupied classrooms, and that the number is lowest in the several types of unoccupied rooms which follow in descending order: vacant assembly rooms, just vacated classrooms and vacant classrooms. It is likewise noted that in every school particularly as regards classrooms, each condition of occupancy tends to follow the trend just referred to. Thus the findings for most of the conditions are highest in schools 1 and 2 and lowest in schools 5 and 6.

There is no question but that the average number of bacteria in the air in enclosed places is very largely influenced by the amount of dust present therein. In order to determine the increase in the number of bacteria produced in air by the stirring up of dust, experiments were performed at the several schools at different times throughout the year, in which unoccupied rooms, whose air at the time was presumably dust-free or nearly so, were swept vigorously, samples of the air being taken before sweeping, immediately after sweeping, and one hour later. The findings which are presented in Table 4 indicate that, on the whole, sweeping increased the number of bacteria threefold, and that the counts returned to the pre-sweeping level no later than one hour after sweeping.

Subway Cars

The subway data have been analyzed by the hour of the day in which samples were taken and by the relative number of persons present in the cars at the time of sampling. Samples were taken between the hours of 8 a. m. and 2 p.m., with the greatest number being obtained at the peak rush hour of 8 a.m. to 9 a.m. A sufficient number of samples were taken between the hours of 9 and 12 (noon), however, to enable the drawing of some conclusions as to the significance of the bacterial numbers then found. The number of persons in the cars being sampled was estimated roughly, each time a sample was taken. Although there are seats for 56 persons in the individual car about 300 persons can be accommodated when all the standing space is occupied.

The findings for almost 1,000 samples are presented on an hourly basis in Table 5 and Fig. 3. A curve based on a two-day census of persons entering the subway which was carried out in May and

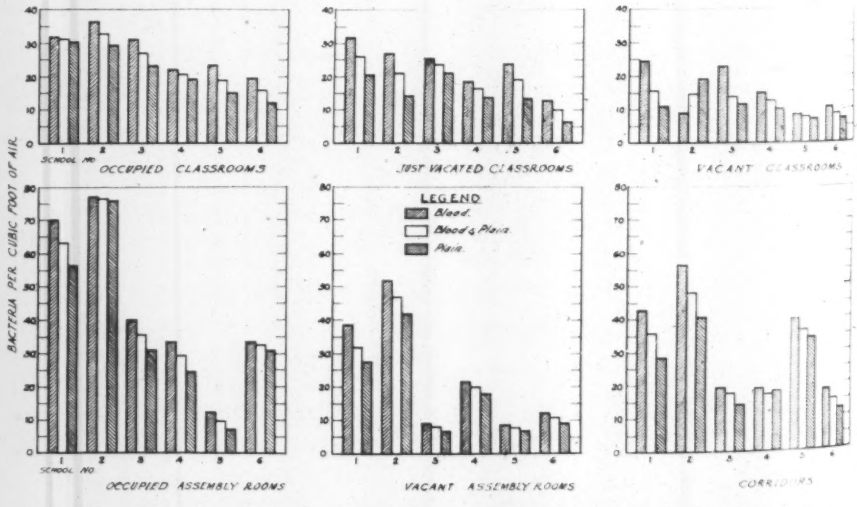

Fig. 2—Average of six conditions at each of six schools for one year

Table 3—The Mean number of Bacteria per Cubic Foot of Air for Six Conditions of Occupancy at Schools.

School No.	Blood Agar		Plain Agar		Blood Agar		Plain Agar		Blood Agar		Plain Agar	
	No. of Samples	No. Per Cu Ft	No of Samples	No. Per Cu Ft	No. of Samples	No. Per Cu Ft	No. of Samples	No. Per Cu Ft	No of Samples	No. Per Cu Ft	No. of Samples	No. Per Cu Ft
	Occupied Classrooms				Just Vacated Classrooms				Vacant Classrooms			
1	71	31.8	72	30.2	37	31.7	37	20.6	11	24.4	10	15.4
2	81	36.2	82	29.4	50	26.7	42	14.3	11	8.8	16	19.0
3	97	31.0	97	23.2	57	25.2	42	20.9	8	22.7	29	11.4
4	99	22.0	102	19.3	44	18.4	38	13.8	21	15.1	24	10.0
5	91	23.2	95	14.9	50	23.7	39	13.6	30	8.2	47	6.9
6	86	19.8	83	11.7	41	12.8	29	6.3	37	10.2	48	6.9
Totals	525	27.0	531	21.1	279	23.2	227	15.3	118	12.6	174	9.7
	Corridors				Occupied Assembly Rooms				Vacant Assembly Rooms			
1	21	42.9	20	28.3	28	69.9	27	56.4	12	38.4	17	27.4
2	14	56.6	17	40.5	23	77.0	22	75.7	14	52.0	16	42.0
3	8	19.5	5	13.9	3	40.0	3	31.0	13	8.9	9	6.6
4	11	17.3	8	19.1	22	33.6	21	24.5	14	21.4	11	18.1
5	9	40.0	12	34.2	4	12.2	4	7.2	13	8.6	14	7.1
6	8	18.0	8	11.9	14	33.4	8	30.8	8	11.9	5	9.1
Totals	71	35.9	70	28.3	94	54.2	85	48.0	74	24.5	72	21.4

June of 1934 by the subway system itself has been added to the data curve in each section of Fig. 3. The curve shows that a maximum number of persons (100 per cent) entered the subway between the hours of 8 a. m. and 9 a. m. A 60 per cent decrease in the number of persons entering was recorded for each of the next two hours, 9 a. m. to 11 a. m. There was a definite increase in the number of persons entering the subway in the next hour 11 a. m. to 12 noon, which was followed by a more marked increase in the succeeding hour of 12 noon to 1 p. m. These data show the general trend of subway travel and are presented as an indication of the probable degree of variation within each of the two arbitrarily selected conditions of occupancy for the hours studied.

The bacterial counts on plain agar for both the full-crowded (containing 75 to 300 persons) and normal (containing less than 75 persons) conditions of occupancy seem to follow in a general way the person load of the subway; the maximum number of bacteria under both conditions of occupancy being found between the hours of 8 and 9 a. m. There is a diminution in the count on plain agar in the condition full-crowded which roughly parallels the decrease in the number of persons entering the subway between the hours of 9 and 10 a. m. The bacterial count, however, continues to decline in the absence of any further decrease in the number of persons entering the subway in the next hour, 10 to 11 a. m. This negative balance may indicate that the number of persons entering the subway at this time is not sufficient to stir up enough bacteria with the dust to counterbalance those settling out from the previous hour. It is not

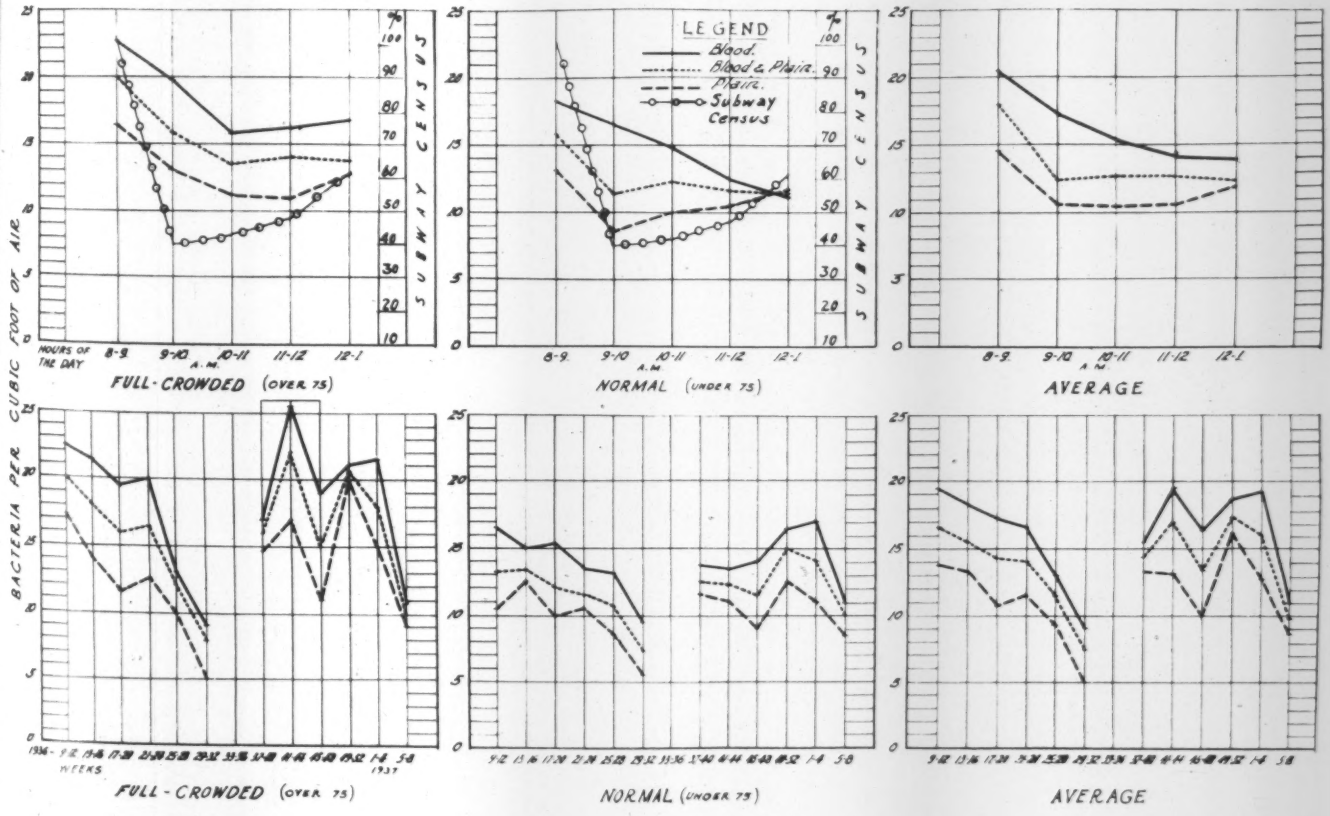

Fig. 3—Subway cars

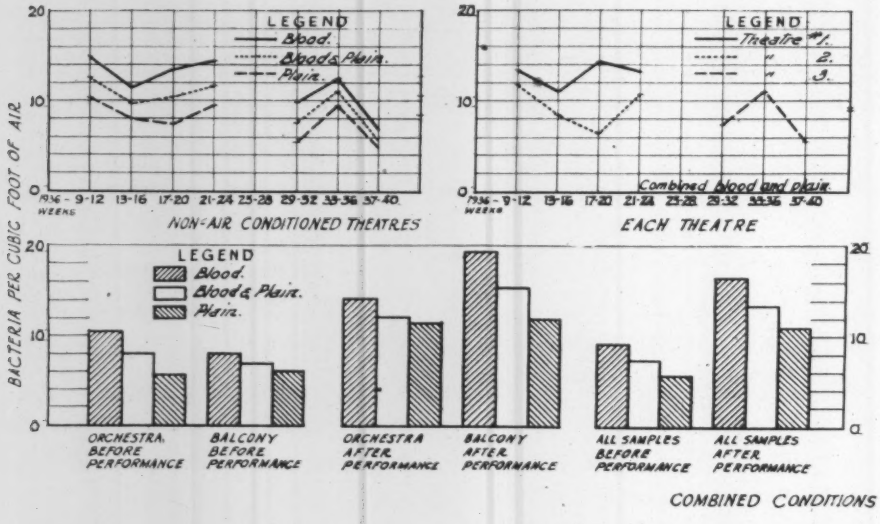

Fig. 4—Non-air conditioned theaters

until the following hour, 11 a. m. to 12 noon that the count on plain agar first reflects the increase in the person census. The count rises again during 12 noon to 1 p. m. when there is an additional increase in the number of persons present.

A more rapid fall of the count on plain agar in the condition normal between 9 a. m. and 10 a. m. may reflect the somewhat lower initial number of bacteria present, as compared with the condition full-crowded, as well as a more critical decline in the number of persons at this time entering cars characterized as normal. Similarly, the increased count beginning during the hour 10 to 11 a. m. and continuing thereafter until 1 p. m. may represent more precisely than the findings under the condition full-crowded the increased number of persons entering the subway system at that time.

The findings on blood agar for the full-crowded condition parallel in a general way, but on a higher level, those for plain agar. Condition normal, on the other hand, shows a steady decline in the blood agar count from 9 a. m. to 1 p. m. despite the increased influx of people between the hours of 10 a. m. and 1 p. m. There is no ready explanation for this apparent anomaly. On the assumption that part of the difference between the blood agar and plain agar counts is ascribable to respiratory organisms which grow only on the former medium the gradual approximation of the two curves might be explained as due to a progressive settling out in the late morning hours of such organisms which were cast off during the 8 a. m. to 9 a. m. peak. However, this assumption appears to be contradicted by the fact that during the 9—10 hour when traffic is at its lowest point, the difference between the two media is greatest. It is of interest that a similar contradiction obtains for the school findings (Table 3). Thus the blood agar-plain agar difference for occupied classrooms is 5.9 organisms per cubic foot whereas that for just vacated classrooms (rooms vacated within one half hour or less of sampling) is 7.9 organisms per cubic foot, a significant increase of 2.0 organisms per cubic foot. On the other hand, in vacant classrooms and vacant assembly rooms and during the later, less crowded morning hours, in the subway (condition normal) the blood agar-plain agar differences tend to become minimal.

The subway data for the two conditions of occupancy are shown in Fig. 3 by four week periods for the equivalent of a calendar year to determine if seasonal trends are indicated. A downward trend in the data is observed from March through August for both conditions of occupancy. This may reflect progressively increased ventilation as first the windows are gradually opened wider, then the doors between cars are opened and finally fans are operated. It is also noticed that on either side of the summer hiatus in the data actual as well as relative decreases in the blood agar-plain agar difference exist.

Non-Air Conditioned Theaters

Three non-air conditioned theaters (legitimate) were studied for 28 weeks of the year 1936. Theaters 1 and 2 were studied in the Spring and Theater 3 in the Fall. The theaters designated as non-air conditioned were older in construction than the air conditioned ones. Theater 2 had no washer or humidity control, used auxiliary radiators and completely discarded used air. Theater 1 did not have an efficient washer and humidity control.

It is seen in Fig. 4 that the total numbers of bacteria during the periods studied remained at a relatively constant level, and that both the orchestra floor and the balcony of these theaters showed fewer organisms before the performance than after.

Table 4—Effect of Sweeping Empty Classrooms on the Average Number of Bacteria in the Air Therein

School No.	BEFORE SWEEPING Blood Agar No. of Samples	BEFORE SWEEPING Blood Agar No. Per Cu Ft	BEFORE SWEEPING Plain Agar No of Samples	BEFORE SWEEPING Plain Agar No. Per Cu Ft	JUST AFTER SWEEPING Blood Agar No. of Samples	JUST AFTER SWEEPING Blood Agar No. Per Cu Ft	JUST AFTER SWEEPING Plain Agar No. of Samples	JUST AFTER SWEEPING Plain Agar No. Per Cu Ft	1 HOUR AFTER SWEEPING Blood Agar No of Samples	1 HOUR AFTER SWEEPING Blood Agar No. Per Cu Ft	1 HOUR AFTER SWEEPING Plain Agar No. of Samples	1 HOUR AFTER SWEEPING Plain Agar No. Per Cu Ft
1	2	7.1	3	4.2	2	11.2	2	13.4	3	7.7	2	4.9
2	3	5.3	3	1.6	4	6.5	4	5.1	2	2.9	3	2.4
3	3	6.1	3	3.6	3	22.0	3	9.3	3	3.9	3	2.3
4	1	2.8	1	3.1	1	16.6	1	12.7	1	6.8	1	11.5
5	5	5.3	5	2.4	5	20.1	4	24.9	4	5.8	6	3.2
6	7	10.5	7	4.0	7	40.2	8	6.1	7	10.4	8	5.2
7	3	13.8	4	6.6	3	47.3	3	29.4	3	13.5	4	4.9
Totals	24	8.0	26	3.8	25	26.2	25	13.0	23	8.0	27	4.3

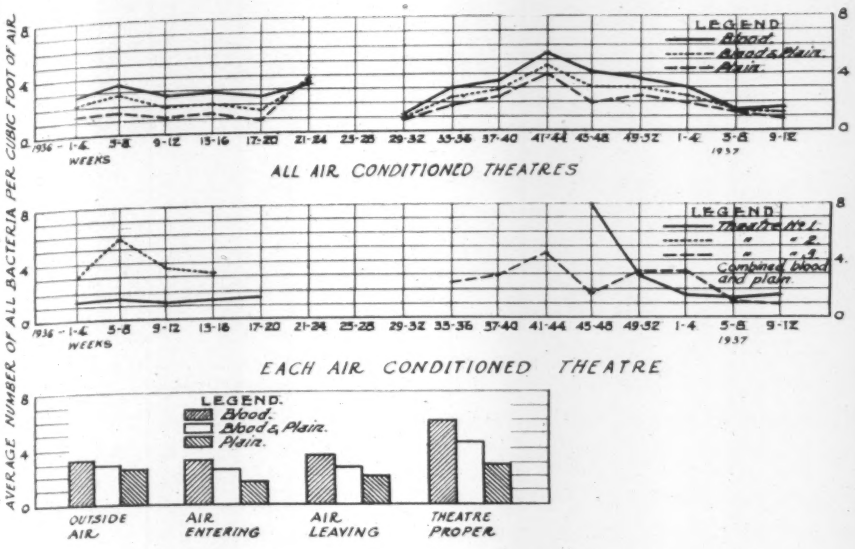

Fig. 5—Several conditions at air conditioned theaters

Air Conditioned Theaters

The findings in the three air conditioned theaters (motion picture and legitimate), which were studied for a longer period of time than the non-air conditioned ones, are relatively consistent as is shown in Fig. 5. The theaters designated as air conditioned are modern in construction and are equipped with late models of air conditioning apparatus. These plants have automatic recording devices for temperature and humidity. Of these only the plant in Theater 2 is equipped with dehumidifiers, ozonizing apparatus and paper filters. The others have washers and positive humidity control. Most of the samples in these theaters were taken directly in the large ventilation ducts. Three different conditions were studied: air entering the theater from the outside, a mixture of re-circulated air and fresh air entering from the outside, and air coming from the theater. In addition, a few samples were taken in the theater proper. A comparison with Fig. 4 shows that the level of the number of organisms present in the theater proper was lower than that of non-air conditioned theaters.

Comparison of the Several Types of Locations by Four-Week Periods

In Fig. 6 is given the combined mean number of bacteria on both plain and blood agar samples at each type of location by four-week periods. It is seen that the mean count for each type of location tends to remain at its own general level, with some exceptions, throughout the year.

Discussion of Results

It is not particularly surprising to find differences in the total bacterial counts of the air in the several types of enclosed places studied. These differences can be largely explained by the interplay of several factors the most important of which would seem to be dust and the bacteria associated with dust, the number of persons present and their activity, and the means available for the venting of bacteria. Thus the counts in subway cars during a period of maximum occupancy when persons are literally *packed in* appear to be significantly lower than those of occupied classrooms in schools where the number of cubic feet of floor area per person is very much greater. This difference in counts is most easily explained by the forced draft venting of bacteria through the overhead louvres and open windows when the subway cars are in motion. On the other hand, the lower counts in vacant classrooms as compared with occupied classrooms and in the uncrowded subway cars as compared with crowded subway cars may be accepted as a direct reflection of a decrease in the person load. Similarly the much higher counts in occupied school assembly rooms as compared with occupied theaters (non-air conditioned) may perhaps be an expression of greater cleanliness and better ventilation in the latter group, of variations in the type of floor covering used, and of the mode of entrance and exit of persons, *i.e.*, whether in large numbers at one time or in small numbers intermittently.

The divergencies found for the several stations studied within a single type of location, as most clearly demonstrated by the six schools, cannot be ascribed offhand to such fundamental differences. Examination suggests, however, that the causes are nevertheless

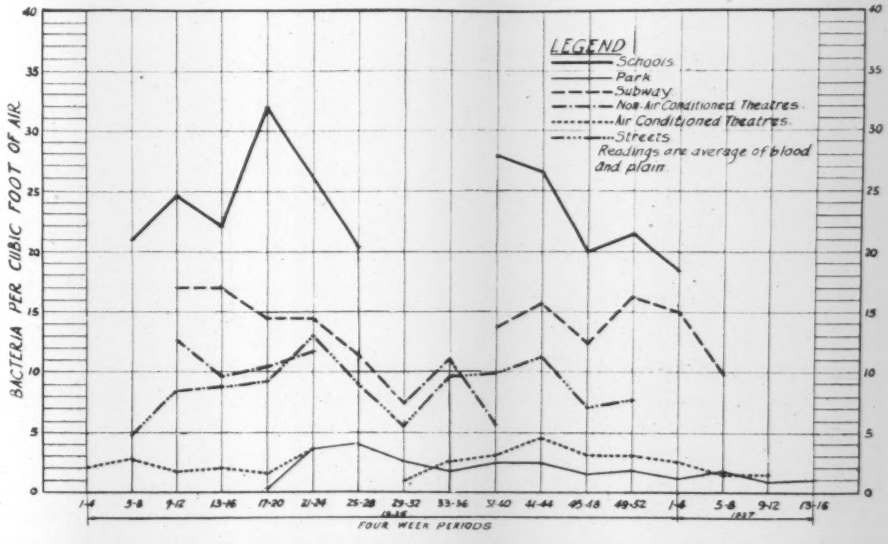

Fig. 6—Average number of all bacteria per cubic foot of air in each type of location by four week periods. Total count over-all locations

Table 5—Mean Number of All Bacteria per Cubic Foot of Air by Hours for Two Conditions of Occupancy
Subway Cars

TIME	CONDITION—FULL-CROWDED Blood Agar No. of Samples	Blood Agar No. Per Cu Ft	Plain Agar No. of Samples	Plain Agar No. Per Cu Ft	CONDITION—NORMAL Blood Agar No. of Samples	Blood Agar No. Per Cu Ft	PlainAgar No. of Samples	PlainAgar No. Per Cu Ft	BOTH CONDITIONS Blood Agar No. of Samples	Blood Agar No. Per Cu Ft	Plain Agar No. of Samples	Plain Agar No. Per Cu Ft
8 a. m. to 9 a. m.	170	22.6	109	16.2	23	18.4	20	13.1	193	22.0	129	15.7
9 a. m. to 10 a. m.	15	19.8	22	13.0	47	16.7	86	8.6	62	17.5	108	9.5
10 a. m. to 11 a. m.	63	15.9	57	11.1	56	14.9	63	9.3	119	15.4	120	10.5
11 a. m. to 12 m.	21	16.1	14	11.0	70	12.3	55	10.7	91	13.3	69	10.7
12 m. to 1 p. m.	5	16.9	14	12.7	9	11.1	42	11.4	14	13.1	56	11.7
Totals	274	20.3	216	14.0	205	14.7	266	10.1	479	17.9	482	11.9

essentially similar. Thus, as previously reported (1) the two schools, 1 and 2, which yielded the highest counts are very old and of definitely inferior construction. They contain small, crowded rooms, which are difficult to clean and have a deficiency of window area. It may also be of interest that the children are of the lowest economic group in the city and come from a health district which shows a high incidence of reportable communicable disease. Schools 5 and 6 which show the lowest counts are high schools located in the middle west side. Although not new, they are of more modern design with large rooms, large windows and high ceilings. School 6 is the only one of the group with a mechanical system of ventilation.

Perhaps the most interesting finding in this report is the implied relationship of the total bacterial counts and the alpha streptococcus counts in schools. Thus when the six schools are listed in descending order from the highest to lowest count by either test (Table 2) they fall into the same progression, an event which would occur by chance alone once in many thousands of times. It should also be noted in pursuing this matter further that the ratio of the total count to the alpha hemolytic streptococcus count for all subway car samples as well as all school samples is of the same order of magnitude, roughly 100 to 1 (Table 1). It is not necessary to explain this relationship between organisms which arise mainly from dust (total count) and those which are originally derived from the human upper respiratory tract (alpha hemolytic streptococci) in order to suggest that, at least in schools, the total count, which roughly parallels the alpha streptococcus count and which because of the much larger numbers of organisms concerned can be more precisely measured, may be used as an indirect measure of human nasopharyngeal contamination.

It is of some interest to compare the findings in this and earlier papers of this series with the findings of others along similar lines but in different types of locations. MacDonald (11) who studied operating and delivery rooms in a hospital found that the average bacterial count was about 23 per cubic foot which compares with our figure of 24 per cubic foot in schools and is not as low as our figure of 15 per cubic foot in subway cars (Table 1). This authors' over-all alpha streptococcus count was 0.06 per cubic foot, a somewhat lower figure than 0.22 per cubic foot in schools reported earlier by us, while his beta hemolytic streptococcus count was 0.02 per cubic foot or a ratio of alpha to beta hemolytic streptococci of 175 to 1, as compared to our somewhat higher one for all types of locations of 40 to 1. MacDonald also states that, "Operating room corridors show a relationship between the amount of activity, the number of individuals and the bacterial condition of the air," and that, "A positive correlation of 0.67 $\pm$0.05 was found between the number of individuals in a given situation and the bacterial counts of the air. This was considered significant."

Hamburger and his associates (12) studied the bacterial flora of the air of hospital wards housing patients infected with beta hemolytic streptococci. They found that the rise and fall in the number of these pathogenic streptococci in air paralleled fluctuation in the total number of saprophytic bacteria in the air. Since the saprophytic bacteria have their origin in the floor dust and bed linen, the authors concluded that most of the beta hemolytic streptococci isolated from the air must also be derived from these secondary reservoirs where they accumulate following the expulsion of respiratory secretions. It is of interest that the ratio of all bacteria to beta hemolytic streptococci in these sick room environments was believed to be at least 500 to 1 as compared with the ratio of approximately 4,000 to 1 in the normal environments reported here.

Torrey and Lake, (13), who studied the practicality of the use of the alpha hemolytic streptococcus as an index of human pollution of the air in a large department store, obtained findings similar to ours. A most interesting finding was that during the course of the year a marked correlation was shown between the number of streptococci of respiratory origin, (alpha, beta, gamma) recovered from air and the prevailing rate of colds as indicated by the medical records of the employees. On the other hand they found that in this type of location the stirring up of dust as measured by total counts was not primarily influenced by human occupancy but rather by the types of merchandise handled.

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STONE HONORED BY STEVENS

John F. Stone, president of the *American Society of Refrigerating Engineers*, was awarded the honorary degree of mechanical engineer by his alma mater, Stevens Institute of Technology, at its commencement exercises held June 27 at Castle Point, Hoboken, N. J.

A member of the Stevens class of 1920, Mr. Stone left before graduation to enlist in the Canadian Royal Air Force, in which he served during World War I.

ELECTRICAL ENGINEERS ELECT WICKENDEN

Dr. William E. Wickenden, president, Case School of Applied Science, Cleveland, Ohio, was elected president of the *American Institute of Electrical Engineers* for the year beginning August 1, 1945, as announced at the annual meeting of the Institute held in New York, June 27. The other officers elected were: Vice-Presidents E. S. Fields, Cincinnati, Ohio; H. B. Wolf, Charlotte, N. C.; L. M. Robertson, Denver, Colo.; F. F. Evenson, San Diego, Calif.; F. L. Lawton, Montreal, Canada; Directors, J. M. Flanigen, Atlanta, Ga.; J. R. North, Jackson, Mich.; Walter C. Smith, San Francisco, Calif.; National Treasurer, W. I. Slichter, New York, N. Y. (reelected).

These officers, together with the hold-over officers, will constitute the board of directors for the next administrative year. The annual report of the Board of Directors, presented at the meeting, showed a total membership on April 30, 1945, of 23,072.

CHAPTER HONORS STROUSE

At the May meeting of the Western New York Chapter the retiring president, S. W. Strouse, received a certificate commending him for the able manner in which he carried out his duties during the year. The presentation was made by B. C. Candee.

The newly elected officers for the 1945-46 season are as follows: President, F. Albert Moesel; 1st Vice President, Herman Seelbach, Jr.; 2nd Vice President, George Adema; Treasurer, B. C. Candee; Secretary, John S. Meyer. The Board of Governors comprises Myron C. Beman, Joseph Davis, W. R. Heath, and Roswell Farnham.

NOTTAGE JOINS ASHVE RESEARCH STAFF

The appointment of Herbert B. Nottage as Research Associate on the staff of the Research Laboratory of the Society at Cleveland, Ohio, is announced by Prof. G. L. Tuve, chairman of the committee on research. Mr. Nottage entered upon his duties on July 1.

A graduate of the University of California, Mr. Nottage received his bachelor's degree in mechanical engineering with honors in 1937 and his master's degree in 1939.

H. B. Nottage

During this period he worked for some time as a research assistant in the Department of Mechanical Engineering on the cooperative research studies on cooling towers sponsored by the ASHVE.

From September 1939 to August 1941 he was instructor in Mechanical Engineering at the Illinois Institute of Technology, Chicago, Ill., and in August, 1941, he joined the research and development engineering staff of Pratt and Whitney Aircraft, East Hartford, Conn., and has been working there on problems of thermodynamics, heat transfer and fluid mechanics.

He was Chairman in 1943 and 1944 of the ASHVE Technical Advisory Committee on Cooling Towers and has been for the past three years secretary of the Heat Transfer Division of the *American Society of Mechanical Engineers*.

He has had a number of research papers published in the TRANSACTIONS of both the ASHVE and *ASME*. He is a member of both these Societies, a junior member of the *American Society of Chemical Engineers*, and is a member of Tau Beta Pi and Sigma Xi.

Ultraviolet as a Protective Agent in Preparation of Pharmaceuticals*

By A. R. Dennington,† Bloomfield, N. J.

INTRODUCTION — There is an active and growing interest on the part of the air conditioning engineer in the accomplishment of air sterilization by means of ultraviolet light and aerosols. This paper, prepared for the Western Section Production Committee, American Pharmaceutical Manufacturer's Association, is therefore of timely interest.

PHARMACEUTICAL preparations require the greatest care and the most modern equipment if they are to be manufactured in commercial quantities and made ready for market in aseptic condition.

The combined efforts of the engineers, physicists, chemists and medical personnel are required to complete a product or group of products which are of the high degree of purity essential for creating the desired reaction without toxic or infectious results.

A rigid routine of sterilizing containers and thoroughly cleaning rooms, laboratories, tables, and equipment has been, for years, standard practice in all pharmaceutical establishments. One source of contamination, the air surrounding the work or the product, has not been treated to remove bacteria because until recently there has been no treatment possible. Within the past few years sterilizing lamps have been developed as a simple, reliable source of bactericidal ultraviolet radiation. They can be installed and operated at low cost to clear the air almost completely of bacteria, mold and other living organisms so that it no longer is a contaminating agent. It is possible, therefore, to provide an additional safeguard in the manufacture or packaging of a product which is exposed to the air, and which subsequently cannot be autoclaved.

During the past two years there has been rather widespread and rapid increase in the number of ultraviolet lamps in pharmaceutical laboratories, but this increase was preceded by an extended period when large manufacturers worked with and tested various ultraviolet generators to determine their effectiveness. These tests indicated beyond question that bactericidal radiation provided a safeguard against infection of products and cross infection of test animals which more than justified the extensive use of ultraviolet generating units in practically every part of manufacturing establishments and biological laboratories. As a result, the number and variety of bactericidal ultraviolet applications has been increased until several pharmaceutical establishments have from 200 to 500 such lamps in continuous service. These ultraviolet generators provide a relatively high percentage of radiated output in the region of 2537 Angstrom Units, which is as close as can be obtained practicably to the most effective bactericidal wavelength of 2600 Angstroms. More than 95 per cent of the ultraviolet total radiation provided by the lamp is at approximately 2537 Angstrom Units.

Short wave lengths, such as 2537 Angstroms and shorter, have very little penetration into liquids or solids. Clear water with only a small amount of dissolved minerals permits the rays to penetrate to appreciable depth, there being about 50 per cent absorption in a 3 in. depth of physiological salt solution and the same amount in a 6 in. depth of distilled water. Solutions containing proteins are nearly opaque to these short rays while clear window glass or optical glass affords complete shielding from them. Because of the lack of penetration these bactericidal rays can be used to protect culture media from air borne contamination without endangering the cultures which may be exposed in the process. Penetration of these rays through air is very good, however, as tests show effective killing of organisms on the surface of culture media on petri plates placed more than 15 ft from an ultraviolet source shielded to have only 1 in. of effective length. In fact, a definite quantity of the weak radiation over a period of several hours was more effective in killing micro-organisms than the same amount of more intense radiation for the same period of time. This increase in lethal effect is explained by assuming that bacteria are more easily killed at some certain instant in their life cycle; therefore, by extending the radiation time, advantage is taken of this weakness.

Every laboratory in a pharmaceutical establishment should be equipped with bactericidal radiation as a protection to the workers as well as to the materials being handled. The culturing of pathogenic organisms in order to develop methods of control and the testing of these cultures and controls on animals involves some risk of the organism contaminating the air and affecting those working in the rooms. Where bactericidal radiation is used, this danger is greatly reduced. Many tests, which have been reported by Dr. Harvey C. Rentschler, indicate that most pathogenic organisms are killed by about half the quantity of bactericidal radiation required for killing B subtilis spores. For example, oberthella typhosa requires 20 to 30 clicks and bacillis anthracis requires 30 to 50 clicks for about 95 per cent kill, while subtilis spores require 50 to 65 clicks. One click on a standard Rentschler meter represents 220 microwatt seconds per square centimeter. In the E. R. Squibb laboratories each step in the preparation of blood plasma is protected by ultraviolet, beginning with the refrigerated receiving

*From a paper prepared for Western Section Production Committee, *American Pharmaceutical Manufacturer's Association.*

†Westinghouse Electric Corp., Bloomfield, N. J.

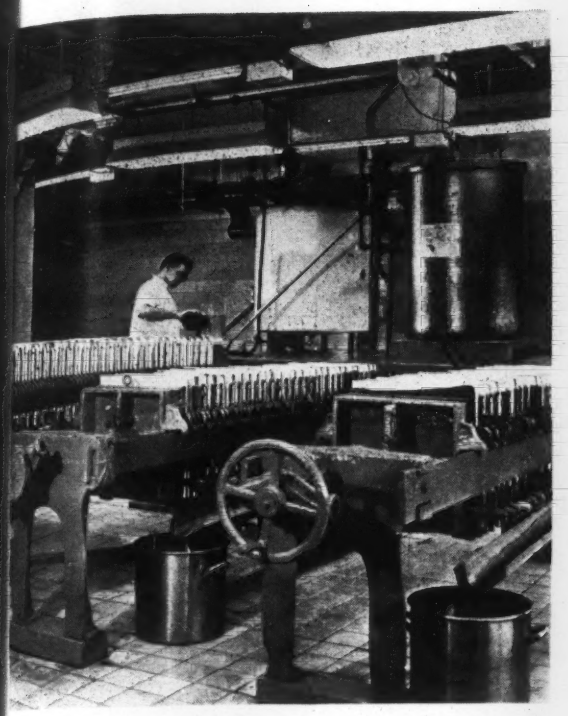


Fig. 1—Use of sterilizing lamps in filter room protects products from air contamination while being filtered

room where the bottled blood from the Red Cross stations is received and stored until it can be processed. As the temperature is maintained at —350 F, the workers wear protective clothing while removing the bottles from the refrigerated shipping containers and checking them before storing on the shelves.

Where serums are filtered, the material is exposed for an appreciable time to the air of the room and it is very important to have the air free from organisms, hence, ultraviolet radiation from sterilizing lamps is provided. These lamps are mounted at the same height as the twelve fluorescent lighting fixtures and spaced between them to give uniformity of radiation. This arrangement also prevents either the lighting units or the ultraviolet lamps being shaded by or interfering with the others (Fig. 1). The radiation is directed into the lower part of the room where the need of protection is greatest. It has been the experience in pharmaceutical laboratories that with ultraviolet radiation in the working areas, the precautions usually taken to prevent contamination of the products yield more positive results than were obtainable without air sanitization. The insurance factor has thus been a valuable aid in protecting that priceless ingredient, the reputation of the manufacturer.

In a typical laboratory (Fig. 2) where work may be performed at a bench or at any other part of the room, general radiation should be provided. It should be noted that tinted or colored glasses or shields are not required for the workers as any ordinary clear glass is opaque to the ultraviolet radiation and hence affords complete protection to the eye. Most transparent plastic shields give the protection required although a few plastics have sufficient transmission of ultraviolet to render them unsuitable as eye protectors.

Areas in which vaccines or other products are sealed aseptically in glass tubes must be carefully protected from air-borne organisms. Usually the ampoule filling and sealing is done behind a glass shield which allows the worker to see the operation but which deflects the breath away from the work, as shown in Fig. 3. An increased measure of safety to the product can be obtained by placing the sterilizing lamps back of the glass shield and about two feet above the table top. The bactericidal radiations are of sufficient intensity at the point where the sealing is done to kill or inactivate most microorganisms within a few seconds. There is little chance that any living organism will survive the barrage of ultraviolet rays long enough to float into an ampoule. Sutures are handled in essentially the same way as ampoules containing vaccines and may be protected by ultraviolet radiation in the same manner. General radiation in the suture processing rooms aids in maintaining aseptic conditions and insuring a sterile product.

In transferring organisms from one culture medium to another, there is always the chance that airborne bacteria will contaminate the new culture. Where this work is done at tables protected by glass shields, it is advisable to install ultraviolet generators back of the shields as suggested for ampoule protection. If no shields are used, it is usually necessary to install ultraviolet lamps on the ceiling of the room and to depend upon general irradiation to prevent accidental infection of cultures. In either type of installation there is no danger of killing or inactivating the culture being transferred because the bactericidal rays of ultra-

Fig. 2—Uniform radiation provided in laboratory by alternating sterilizing lamp units and fluorescent fixtures suspended at the same level throughout the room

violet have practically no penetration into the cultures or media. Thus, only a minute surface layer of organisms are affected by the rays but organisms floating in the air are fully exposed to the radiation and are killed.

The extreme sensitivity of the materials and processes in the production of penicillin to infection by air-borne organisms has caused practically all manufacturers to use the sterilizing lamps as an added prophylactic agent. Ultraviolet radiation stands guard whenever air can come in contact with the culture materials, the air in the incubation room or the air supplied to the culture in the tank method, to keep out unwanted organisms. In the packaging room, where the completed product is placed in the final containers, radiation completes the guard set up to prevent contamination.

As glass containers are very largely used in packaging pharmaceutical products and as these containers are practically always for single use, ultraviolet radiation permits the containers, either bottles or jars, to be supplied to the manufacturer in practically sterile condition. The Brockway Glass Co. makes use of the fact that as the bottle is formed from the molten glass it is at a temperature which makes it impossible for any living organism to be in it. The problem then becomes one of keeping the container from becoming contaminated from the air as it cools and capping it in a germ-free atmosphere before shipment. To accomplish this the air supplied to the lehr is first passed through a chamber and irradiated by means of sterilizing lamps. This air flows in a direction opposite to the movement of glassware through the lehr so that the coolest air comes in contact with the coolest bottles. The bottles are delivered to a hooded space equipped with ultraviolet lamps and are closed with caps which have had the interior irradiated. In this way bacteria-free containers can be shipped to the user. These containers in order to maintain the aseptic quality must be opened and filled under ultraviolet radiation.

For office workers protection against air-borne organisms can be obtained by shielded radiation units of the wall type or pendant type, designed so that direct and strongly reflected radiation is kept out of the occupied area. Shielded radiation of this type is most effective when there is no rapid forced circulation of the air. The fixtures are constructed to allow free radiation of the room above eye level and perhaps a narrow band along the wall below the fixture. Convection currents carry the air upward into the field of radiation where, to a large extent, the organisms are killed or inactivated and the danger of cross-infection correspondingly reduced. Rising or descending air currents along the walls come into the radiated area near the fixtures and receive additional treatment.

Buildings or rooms supplied with air through air ducts from an air conditioning or air circulating system present a somewhat different problem. The movement of air through the circulating system tends to build up a high degree of contamination if no radiation is used, since usually 50 to 75 per cent of the air is recirculated as is necessary for economy in heating or cooling. By placing a group of sterilizing lamps in an enlarged section of the main air duct (Fig. 4), a high intensity of radiation is built up which will kill practically all the living organisms in the air as it passes the lamps. This treatment insures a supply of air, practically free of germs, to the occupied space and is equivalent to circulating all fresh or germ-free air in the system. A low bacteria count can be maintained and the danger of infection of workers and the product materially reduced. Tests made at the points where air is delivered from the ducts to the room have indicated a reduction of more than 90 per cent in the bacteria entering with the air as compared to the conditions existing when the radiation is not used. It also has been noted that odors are greatly reduced or are eliminated.

When proper precautions are taken, the installation of sterilizing lamps in an air duct does not increase the hazard of smoke or fumes being distributed throughout the building. There is no hot filament in the lamp and the temperature of the tube itself and the column of mercury vapor within it is low enough to feel only warm to the touch. The high tension wiring within the duct may be bare copper if a spacing of at least 1 in. is maintained between the wire and any grounded metal. Noncombustible, non-absorptive insulators are used to support the wire, thus eliminating rubber covering. Inspection windows of clear wired glass per-

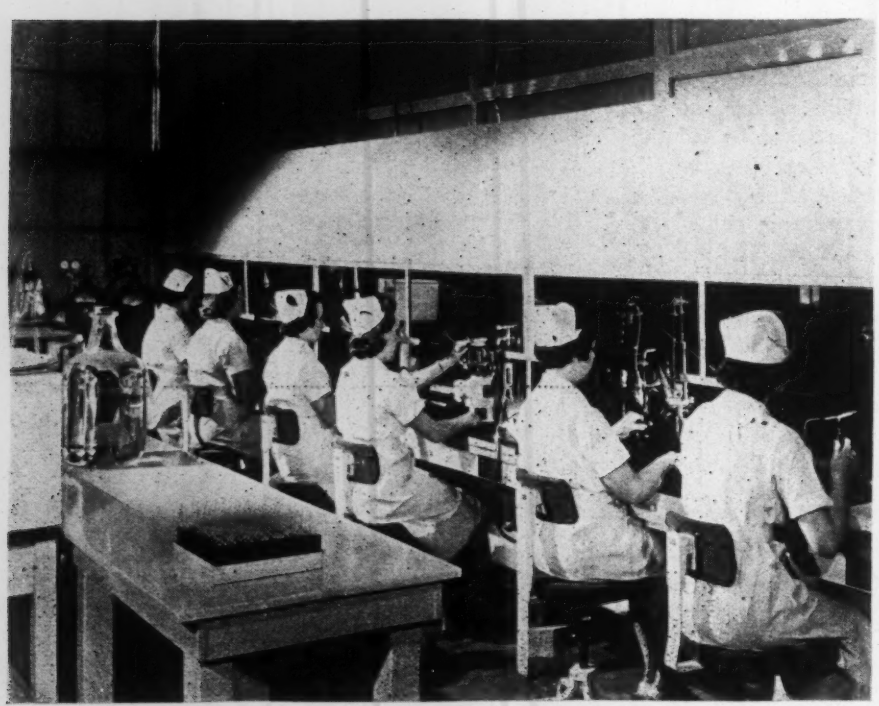


Fig. 3—Ampoule filling operation protected by sterilizing lamps back of shield

mit observation of the lamps. Service doors fitted with switches which cut off the electric power when the doors are opened allow access to the chamber for cleaning, testing, and replacing lamps without exposing the workman to either high voltage or high intensity radiation.

Ultraviolet generators are installed in animal rooms of numbers of manufacturers of pharmaceutical products. For example, general irradiation of the rooms where animals used for inoculation tests are kept in the plant of E. R. Squibb & Sons, Inc., New Brunswick, N. J., is for the purpose of reducing danger of cross-infection among animals in different cages. Small animals, such as mice, rats, guinea pigs, rabbits, etc. (Fig. 5) are usually kept in cages which have bars or gratings at the front and openings near the top of sheet metal sides for ventilation and light. Where the construction is such as to prevent direct passage of air from cage to cage, the path of possible air-borne infection is out into the room where there is bactericidal radiation. These rays kill or weaken the bacteria or virus and thus greatly reduce the danger of infection. Studies of inoculations can thus be made with greater certainty than without ultraviolet radiation in the room. Workers in an irradiated room can be protected by eye shields, preferably supplemented by eye shades or caps with visors. This prevents direct or reflected radiation from reaching the eyes and causing temporary but painful conjunctivitis. The eyes of animals being ordinarily more exposed to sunlight than the eyes of humans are not easily affected by bactericidal radiation, and in case of overexposure, recovery is rapid. The continuous reduction of the number of living organisms in the air counteracts, to a great extent, the number which is being added by the exhalations of the animals and the disturbance of the litter in the cages, thus preventing the development of a large population of micro-organisms in the air.

Fig. 5—An installation of lamps in a small animal room to reduce danger of cross-infection and reduce odors

The larger animals such as horses and cattle, which are used as a source of blood for serums and vaccines, must be kept under the most sanitary conditions possible to insure their continued health and freedom from even temporary infection. In addition to having the most modern equipment and maintaining it in scrupulously clean condition, ultraviolet lamps are installed on the ceiling over the animals for the purpose of sanitizing the air and minimizing odors. Continuous radiation of the air, walls and floor in this section of the building provides a more sanitary environment for the animals than previously has been obtainable. The radiation of the air gives sanitary control to an element which, until the present, could not be given purifying treatment comparable to that which is provided for food and water.

The applications of germicidal ultraviolet radiation in pharmaceutical establishments which have been described are general in character. Many special applications will be found for the radiation method of sanitizing air in this industry to permit standards of purity of products exceeding those which have been possible without the safeguard of ultraviolet.

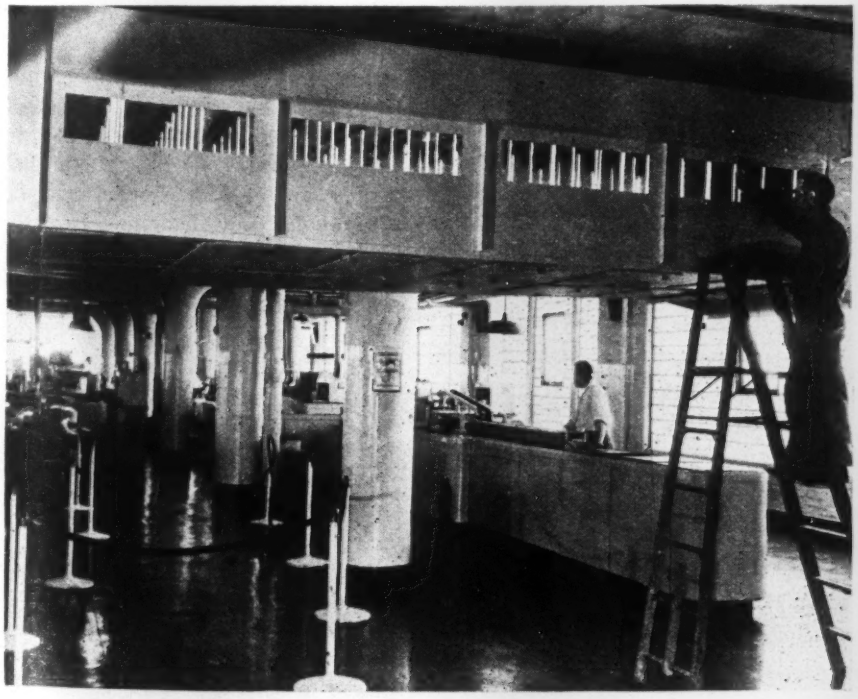
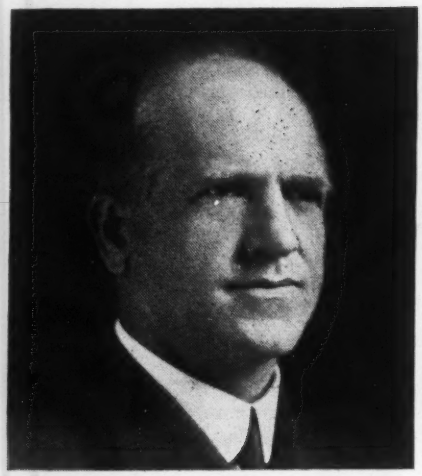


Fig. 4—Sterilizing lamp installation in air duct supplying practically germ-free air to packaging section

SOCIETY ANNOUNCES MEMORIAL LIBRARY AT RESEARCH LABORATORY



John R. Allen

THE ESTABLISHMENT of the John R. Allen Memorial Library by the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, has just been announced. It is planned that this Library of books, pamphlets, and other printed matter dealing with the arts and sciences of heating, ventilating and air conditioning will be located in the Society's Research Laboratory. Authors of text books and reference books are invited to contribute gift copies and members and friends of the Society are urged to send text books and any other printed material of historical value to this newly created Library. A special bookplate has been prepared and will be placed in each volume in the Library and all contributed volumes will bear the name of the donor.

All contributions should be sent parcel post or express collect to the Director of Research, ASHVE Research Laboratory, 10700 Euclid Avenue, Cleveland 6, Ohio.

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The
JOHN R. ALLEN MEMORIAL LIBRARY

The American Society of Heating and Ventilating Engineers

Because of his pioneer work in the establishment of the ASHVE Research Laboratory and as its first director, it was considered fitting by the Committee on Research that the Library should commemorate the memory of John R. Allen.

He was a man who combined the characteristics of the educator, the scientist and the engineer. He was a prolific writer and contributed such well known reference books as, Notes on Heating and Ventilation and Heating and Ventilation to the literature.

Dean Allen served as president of the Society in 1912 and became active head of the Society's Research Laboratory at the Bureau of Mines, Pittsburgh, Pa., on August 1, 1919. He had the unique distinction of serving as president of the Michigan Chapter, the Minnesota Chapter and was President-elect of the Pittsburgh Chapter at the time of his death.

He was born in Milwaukee, July 23, 1869, graduated from the University of Michigan in 1892, received his Master's degree in M. E. in 1896, and joined the faculty of the University of Michigan and served there until 1911. He then went to Turkey as head of the engineering department of Robert College and in 1915 returned to the University of Michigan and was head of the Department of Mechanical Engineering. In 1917 he became Dean of the College of Engineering and Architecture of the University of Minnesota.

After serving as Director of the ASHVE Research Laboratory for a little more than a year, he died on October 26, 1920, at the age of 51. He laid the foundation for the research work of the Society which is now entering its 26th year.

Now, as the 25th anniversary of his death approaches, his many friends in the Society believe that his name should continue to be closely associated with the future development of the Society's research work.

SUMMARY OF LOCAL CHAPTER MEETINGS

CENTRAL OHIO CHAPTER, June 9. Summer outing on grounds of Schultz club. The committee consisted of A. H. Wolfe and G. L. Long.

CENTRAL OHIO CHAPTER, May 21. Speaker: J. K. Knighton, Sales Manager, Air Conditioning Div., Servel, Inc., Evansville, Ind. Other features: Treasurer's report approved. Engrossed certificate presented to J. D. Slemmons, retiring president. Attendance, 60. Attendance ratio, 0.61.

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CONNECTICUT CHAPTER, May 9. Subject: Experiences on Active Duty in the Mediterranean Theater of War. Speaker: Lt. Comdr. J. D. Lodge, USNR. Other features: Annual reports. Election of officers—President, Stanley Hart; Vice-President, L. E. Seeley; Treasurer, J. R. Smak; Secretary, Winfield Roeder; Board of Governors, P. D. Bemis, S. R. Osborne, L. A. Teasdale. Other features: Pictures of the Salerno landing of the second battle of the Philippines. Attendance, 52. Attendance ratio, 1.1.

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GOLDEN GATE CHAPTER, May 16. Theater Air Conditioning From the Buyers' Viewpoint. Speaker: Comdr. J. W. Bantau, USNR, former engineer, Fox West Coast Theaters. Other features: Election of officers—President, R. B. Holland; Vice-President, James Gayner; Treasurer, O. W. Johnson; Secretary, F. W. Kolb; Board of Governors, K. F. Baldwin, H. V. Hickman, D. I. Murphy, C. L. Peterson. Members stood in silence in respect to the memory of two Life Members, W. E. Leland and J. I. Krueger. Attendance, 41. Attendance ratio, 0.56.

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INDIANA CHAPTER, June 1. Subject: Demonstration of Jet Propulsion in Model Form. Speakers: Messrs. Beckman and Lane, Allison Div., General Motors. Other features: J. G. Hayes, S. E. Fenstermaker and W. T. Miller were elected to honorary membership. Attendance, 78. Attendance ratio, 0.67.

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MANITOBA CHAPTER, June 7. Election of officers—President, F. T. Ball; Vice-President, R. E. Moore; Secretary-Treasurer, D. S. Swain. Attendance, 14.

MANITOBA CHAPTER, April 17. Subject: Heat in Harness. Speakers: W. H. Evans and V. J. Jenkinson, Minneapolis-Honeywell, Ltd. A film was shown to illustrate talk.

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MEMPHIS CHAPTER, May 10. Subjects: Heating, Ventilating and Air Conditioning in the Latin American Countries. Speaker: Alfred J. Offner, 1st Vice-President of ASHVE, New York, N. Y. Neutralizing Odors in Air Conditioning Systems, by L. S. Green, W. H. Wheeler Co. Other features: Newly elected officers were installed: President, T. J. O'Brien; Vice-President, R. H. Hoshall; Treasurer, E. E. Scott; Secretary, A. T. Bevil. Attendance, 26. Attendance ratio, 1.04.

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MICHIGAN CHAPTER, May 22. Annual meeting. Memory book and lapel pin were presented to W. H. Old, retiring president. Officers elected—President, R. F. Connell; Vice-President, F. R. Bishop; Treasurer, E. F. Hude; Secretary, A. E. Knibb. Other features: Resolutions of sympathy were adopted in the passing of C. F. Heydon and W. A. Russell, 2nd Vice-President of the Society. Attendance, 72. Attendance ratio, 0.58.

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MONTREAL CHAPTER, May 22. Inspection trip through plant of Warden King, Ltd., Montreal. Other features: Routine business matters settled. It was announced that golf meeting would be resumed in June. President Madden appointed a golf committee consisting of John Colford, Chairman, A. M. Peart, and Raymond Martin. Attendance, 33. Attendance ratio, 0.42.

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NEBRASKA CHAPTER, May 15. Annual meeting. Financial report was submitted by D. D. Williams, Treasurer. Election of officers—President, D. E. McCulley; Vice-President, Henry Kleinkauf; Treasurer, Verne Simmonds; Secretary, D. D. Williams; Board of Governors, B. K. Eaton, C. O. Ruchte. Attendance, 16.

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NEW YORK CHAPTER, May 21. Subject: The Air Cooled Human Body. Speaker: C.-E. A. Winslow, New Haven, Conn., President of ASHVE. Other features: Installation of officers—President, H. J. Ryan; Vice-President, W. A. Sherbrooke; Treasurer, W. M. Heebner; Secretary, C. H. Flink. Attendance, 70. Attendance ratio, 0.31.

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NORTH TEXAS CHAPTER, May 21. Subject: Radiators and Coolers. Speaker: L. P. Saunders, Lockport, N. Y., Treasurer of ASHVE, Chief Engineer, Harrison Radiator Div., General Motors. Other features: Messrs. Martyn, Brown, and Sampson reported on status of the Proposed State Code to Govern Air Conditioning Contractors. Attendance, 43. Attendance ratio, 0.86.

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OKLAHOMA CHAPTER, June 1. Annual election of officers—President, Earle W. Gray; Vice-President, C. Y. Trowbridge; Secretary-Treasurer, G. T. Donceel. Other features: Discussion on strengthening chapter membership. Attendance, 7. Attendance ratio, 0.70.

Note: The attendance ratios shown above represent the meeting attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be helpful in deciding on subjects for chapter meetings.

OKLAHOMA CHAPTER, May 22. Subject: Automotive and Aviation Heat Transfer Surface Development. Speaker: L. P. Saunders, Lockport, N. Y., Treasurer, ASHVE. Interesting discussion followed. Attendance, 16.

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ONTARIO CHAPTER, May 14. Subject: Post-War Confusion. Speaker: Lance Rumble. Election of officers—President, J. P. Fitzsimons; Vice-President, V. J. Jenkinson; Secretary-Treasurer, H. R. Roth; Board of Governors, D. A. Stott, E. G. Spall, A. J. Strain, A. S. Morgan. Annual meeting reports—C. D. Waldon, Chairman, Attendance Committee; L. E. Fagan, Chairman, Entertainment Committee; E. G. Spall, Chairman, Greeters Committee; W. H. Evans, Chairman, Membership Committee; E. R. Gauley, Chairman, Publicity Committee; J. P. Fitzsimons, Chairman, Program Committee; A. J. Strain, Chairman, Papers Committee. Other features: Pres. Fitzsimons presented Mr. Morgan with Past President's Certificate. Attendance, 75. Attendance ratio, 0.54.

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PITTSBURGH CHAPTER, May 14. Annual meeting. Subject: Changes in the Constitution and By-Laws. Speaker: F. C. McIntosh. L. S. Maehling gave the Treasurer's report. E. C. Smyers submitted report on membership and the report of the Nominating Committee. Attendance, 35. Attendance ratio, 0.49.

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ROCKY MOUNTAIN CHAPTER, May 9. Subject: Small Water Tube Boilers and Some Factors Regarding Their Selection. Speaker: J. J. Parce, Power Plant Engineer, Stearns-Rogers Co., Denver, Colo. Other features: Messrs. Allen, Hall, Hook, Payne, and Waterman were appointed to serve on Nominating Committee. Attendance 30. Attendance ratio, 0.48.

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ST. LOUIS CHAPTER, May 1. Subject: The Conduit System of Air Conditioning. Speaker: H. C. Hoffman, Carrier Corp. Other features: C. F. Boester spoke on change in nominating procedure. Election of officers—President, W. J. Oonk; 1st Vice-President, B. C. Simons; 2nd Vice-President, B. L. Evans; Treasurer, J. S. Rosebrough; Secretary, W. A. Russell; Board of Governors, L. L. Hamig, G. B. Rodenheiser, Louis Steckhan, R. T. Toensfeldt. Attendance, 43. Attendance ratio, 0.65.

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SOUTHERN CALIFORNIA CHAPTER, May 9. Subject: Free Enterprise—Post-War Problems. Speaker: Bill Roberts, Assistant General Manager, Pacific Fabricating Co. Election of officers—President, Maron Kennedy; Vice-President, Art Theobald; Treasurer, R. A. Farr; Secretary, R. A. Lowe; Board of Governors, Leo Hungerford, W. O. Stewart, James Deffen, J. S. Earhart. Treasurer submitted report on financial condition of chapter. Attendance, 37.

SOUTH TEXAS CHAPTER, May 18. Subject: Automotive and Aviation Heat Transfer Surfaces. Speaker: L. P. Saunders, Lockport, N. Y., Treasurer of ASHVE, Chief Engineer, Harrison Radiator Div., General Motors. Election of Officers—President, J. A. Walsh; Vice-President, B. P. Fisher; Treasurer, C. C. Quin; Secretary, D. M. Mills; Board of Governors, F. C. Brandt, L. L. Ladewig. Other features: A special gavel was presented to A. F. Barnes, retiring president. Attendance, 46.

SOUTH TEXAS CHAPTER, April 20. Subject: Heating and Ventilating in Shipbuilding. Speaker: E. C. Pugh, Engineer, Todd-Houston Shipbuilding Co. Other features: Maurice Benson, Dallas Chapter, discussed Senate Bill No. 226. Attendance, 30.

SOUTH TEXAS CHAPTER, January 19. Subject: Gas Air Conditioning, Present and Post-War. Speaker: M. P. Noll, Sales Engineer, Servel, Inc. Other features: D. M. Mills reported on the Engineers Council of Houston. A. J. Natkin reported for membership committee. Attendance, 24.

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WESTERN MICHIGAN CHAPTER, May 26. Annual meeting. Installation of newly elected officers. J. W. Miller acted as secretary in absence of Mr. Harbin. Pres. Bratt released the committees that served during the year with a vote of thanks.

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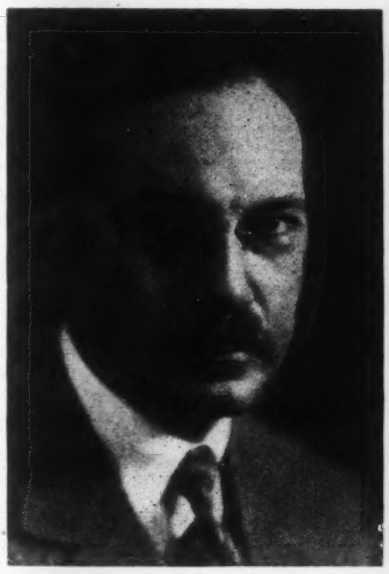
WESTERN NEW YORK CHAPTER, May 14. Film on industrial lighting, "Let Us See," presented through courtesy of Buffalo Niagara Electric. Other features: Election of officers—President, F. A. Moesel; 1st Vice-President, Herman Seelbach, Jr.; 2nd Vice-President, G. E. Adema; Treasurer, B. C. Candee; Secretary, J. S. Meyer; Board of Governors, M. C. Beman, Joseph Davis, W. R. Heath, Roswell Farnham. B. C. Candee gave the financial report. Attendance, 29.

ASA BROADENS SCOPE OF POST-WAR WORK

Changes in the constitution of the *American Standards Association* that will enable it to meet more fully the needs of government and industry in the post-war period were announced recently by Secretary P. G. Agnew. The national trade, technical, and governmental groups that make up the *American Standards Association* have ratified these changes, the principal one of which will remove present restrictions limiting the work of ASA "to those fields in which engineering methods apply" so that the organization can in future handle any standard or standardization project which is in the field of engineering or consumer goods or in any other field which deserves national recognition.

Another change provides for specific mention of the consensus principle of the constitution. A third change provides for election to the Board of Directors of three members-at-large. At present all but the ex-officio members of the Board are nominated in rotation by the Member-Bodies. The additional members-at-large will make it possible to enlist the services of outstanding persons from groups not otherwise represented, thus making the board still more broadly representative.

PAST PRESIDENT THORNTON LEWIS DIES



The many friends of Thornton Lewis will be shocked and grieved to learn of his sudden passing on July 4 at his home, Holiday Hill, Newtown, Pa. Apparently in his usual good health until the day of his death, he passed away quietly at the age of 58.

Until recently Mr. Lewis had served as Chief of the Public Service Branch of the Army Service Forces, Washington, D. C., and previously he spent two years as Deputy Chief of the Procurement Service Branch, U. S. Army Ordnance Department.

Mr. Lewis was born in Versailles, Ky., May 6, 1887, attended the public schools of Frankfort, Ky., and was graduated from the University of Kentucky in 1906. He started his business career in the Engineering Department of the Buffalo Forge Co., Buffalo, N. Y., and then for five years represented that company in New York. He went to Philadelphia for two years as a member of the firm of Murphy and Lewis, specializing in drying and air conditioning systems. For the following 10 years he was a partner in the firm of Lewis, Robinson and Gant, engaged in heating, ventilating and mechanical equipment design, and during that time he was a special consultant for E. I. Dupont de Nemours & Co. and handled heating and ventilating of the various plants including powder works at Carney's Point, Hopewell, Va., Old Hickory, Tenn., and a shell loading plant at Williamsburg, Va.

In 1921 Mr. Lewis became interested in the York Heating and Ventilating Corp. and served as its president and general manager. He was a pioneer in the manufacture of unit heaters and held patents on an electric control system which was used extensively. The business was then merged with Carrier Corp. and for six years Mr. Lewis served as executive vice-president. For two years he served as president at the Pulp Products Co., New York manufacturers of cardboard containers. He retired from active business in 1937.

Mr. Lewis became a member of the Society in 1919 and was one of its most energetic members, in the advancement of its research and other technical activities. He did outstanding work on many of its Technical and Code Committees and served as Chairman of the Committee on Research in 1922. In 1923 he was elected a member of the Council and he headed such important committees as the Executive and Finance. In 1929 at the 35th Annual Meeting in Chicago he was elected president of the Society.

As president he had three main objectives, the establishment of a Society Endowment Fund, encouragement of closer cooperation with other organizations having allied interests, and bringing the membership of the Society past the 2000 mark to the highest point in its history at that time.

During his many years of active service in the Society he was identified with several important changes in Society policy, notably, the change in the publication policy and the inclusion of the Journal Section in Heating, Piping & Air Conditioning, and the sponsorship of the First Heating and Ventilating Exposition, under the auspices of the Society.

Always a loyal alumnus of the University of Kentucky, and an ardent admirer of its beloved Dean of Engineering, F. Paul Anderson, Mr. Lewis created the F. Paul Anderson Fund in January 1930 providing for the award of a gold medal, "to some member of the ASHVE in recognition of work done, or services performed in the field of heating, ventilating and air conditioning." Since that time, the F. Paul Anderson Medal has been awarded to Dr. W. H. Carrier, 1932; Dr. A. C. Willard, 1936; Prof. F. B. Rowley, 1939; Dr. F. E. Giesecke, 1942, and Dr. F. C. Houghten, 1944.

Mr. Lewis gave generously of his time and energy to the service of the Society and he enjoyed a wide circle of friends in the organization.

He was an able executive, an inspiring leader and he was greatly interested in encouraging younger men in the profession about whom he said: "They need the Society today and we need them, for they will be the engineers, executives and manufacturers of tomorrow."

Mr. Lewis typified the Kentucky gentleman, a delightful companion, kindly, considerate and warmly sympathetic, but at the same time modest and unassuming. He received many honors and one that he prized highly was the first and only citation of its kind to be awarded by the Ordnance Department of the United States Army which stated, "Thornton Lewis has rendered distinguished service to his country in the struggle to maintain the freedom of all people. By the exercise of his initiative and ingenuity he has made a marked contribution to the war production program."

In 1943 Mr. Lewis wrote the following tribute to one of the Society's Charter Members, A. C. Edgar of Philadelphia, "To know him was to have a real affection for him. It would be selfish realizing our loss, to wish him here when he has gone on to his reward, but we shall miss him, and seldom if ever again shall we look upon his equal." This might have been written *for* Mr. Lewis.

The Officers and Council extend their sincerest sympathy to his family: Elsie V. Lewis, his wife; three sons, Thornton Jr., of North Plainfield, N. J.; Lt. Daniel G., USNR, Seattle, Wash.; Lt. F. Allen, Army, and a daughter, Mrs. Kent J. Terry of New Hope, Pa.

Funeral services were conducted at his home, Holiday Hill, on July 6 and interment was in the private family plot on the farm.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the Journal of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 49 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by July 16, 1945, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	REFERENCES	
	Proposers	*Seconders*
ANDERSON, NATHAN B., Owner, Temperature Equipment & Engineering Co., Houston, Texas.	A. J. Natkin F. C. Brandt	A. G. Shearer E. R. Thomas
BAHNSON, AGNEW H., JR., Vice-Pres., The Bahnson Co., Winston-Salem, N. C.	Arvin Page James Marshall	De Parx Stimson M. D. Brown
BOEHM, JOHN C., JR., Engr., The John C. Boehm Co., Cleveland, Ohio.	G. B. Bodwell John Richmond	W. A. Evans S. F. Schultz
BURCH, WALTER E., Engr., Winterbottom Supply Co., Waterloo, Iowa.	J. W. Winterbottom *D. C. Knight	*H. A. Rynearson *R. M. Anderson
CAZIN, GERALD R., Co-owner, Cazin & Houtz, Evanston, Wyo.	J. T. Young, Jr. E. V. Gritton	D. R. Wilde H. G. Richardson
CHADWICK, GEORGE R., Capt., Wright Field, Area "A," Dayton, Ohio.	M. J. Gibbons T. R. Walker	I. C. Baker J. W. Layton
CHYTRAUS, OSCAR E., Mfrs. Agent, 1173 South 11th East, Salt Lake City, Utah.	H. G. Richardson J. H. Lym	E. V. Gritton R. C. Brown
CLARK, ALLAN M., Joint Mgr., Canadian Blower & Forge Co., Ltd., Toronto, Ont., Canada. *(Advancement)*	V. J. Jenkinson W. H. Evans	R. S. Mathison E. G. Spall
DE LUCIA, F. ARTHUR, Estimator, A. J. Mongillo Co., New Haven, Conn.	Winfield Roeder T. J. Converse	L. A. Teasdale J. R. Smak
EVANS, S. M., Engr., Winterbottom Supply Co., Waterloo, Iowa.	J. W. Winterbottom *D. C. Knight	*E. W. Juhl *E. F. Gauger
FITCH, WILBUR R., Asst. Fdry. Engr., E. B. Badger & Son's Co., Boston, Mass.	Adolph Ehrenzeller F. H. Brigham	C. E. Flint W. T. Jones
FRANK, GEORGE D., Indus. Div. Mgr., York-Shipley, Inc., York, Pa.	J. J. Mirabile E. R. Walsh, Jr.	L. J. Du Bois W. E. Zieber
GAD, ALFRED, Cons. Engr., 36 Malika Farida St., Cairo, Egypt.	H. M. Zaki Kamal Ezz-El-Din	Sobhi Girgis Shawki Mohsin
GRISWOLD, EDGAR A., Devel. & Design Engr., Aerojet Engineering Co., Pasadena, Calif.	Leo Hungerford Art. Theobald	R. A. Lowe Maron Kennedy
GUEST, ROSS B., Owner, The Guest Sheet Metal Works, New Orleans, La. *(Advancement)*	C. B. Gamble W. H. Dudley, Jr.	W. H. Grant, Jr. L. V. Cressy
HARMAN, RALPH H., Archt., 2 W. Columbia St., Springfield, Ohio.	J. D. Slemmons H. R. Allonier	Richard Hegele L. J. Nichols
HARRIGAN, JOHN E., Plant Facilities Engr., U. S. Time Corp., Waterbury, Conn.	Winfield Roeder C. L. L'Hommedieu	T. J. Converse L. A. Teasdale
HENZEL, JOHN H., Mech. Engr., Arthur G. McKee & Co., Cleveland, Ohio.	W. M. Lowe Philip Cohen	J. F. Mehlek J. E. Wilhelm
HILTON, THOMAS H., Gen. Mgr. & Chief Engr., Ball Washing Machine Corp., Passaic, N. J.	G. E. Smyth Thomas Baker	D. J. Mulholland L. J. Wachs
JENKINS, CHARLES W., Engr., Taco Heaters, Inc., Washington, D. C.	J. C. Barnes Robert Levy	E. T. Houlihan W. C. Jones
JOHNSON, CARL W., Mech. Engr., Mountain States Tel. & Tel. Co., Denver, Colo.	J. H. McCabe L. R. O'Rear	A. W. Cooper F. L. Trautman
JONES, JOHN D., Owner, Bryant Gas Heating Co., Cincinnati, Ohio.	H. A. Pillen A. W. Edwards	A. L. Hard O. W. Motz
KILLEEN, THOMAS F., Dist. Mgr., Struthers Wells Corp., Buffalo, N. Y.	Joseph Davis D. J. Mahoney	M. C. Beman B. C. Candee
KNEESE, VICTOR C., Branch Mgr., General Controls Co., Dallas, Texas.	F. A. Rodgers W. A. Catlett	W. F. Kaun Oslin Nation
MASON, RAYMOND P., Engr., U. S. Army Transport Service, Fort Mason, Calif.	R. B. Holland J. F. Kooistra	N. H. Peterson H. V. Hickman
MILNER, JOE W., Engr., Westinghouse Electric Corp., Atlanta, Ga.	W. J. McKinney F. E. Baird	R. B. Kitch E. W. Klein
MILTON, TAYLOR, Lt., USNR, U. S. Naval Air Station, Minneapolis, Minn.	Lyman Gross M. E. Quigley	W. A. Braun J. M. Townsend
MIRABILE, J. JAMES, Engr., York-Shipley, Inc., York, Pa. *(Adancement)*	E. R. Walsh, Jr. W. E. Zieber	L. J. Du Bois S. F. Nicoll
MONGILLO, ALPHONSE J., Prop., A. J. Mongillo Co., New Haven, Conn.	Winfield Roeder T. J. Converse	L. A. Teasdale J. R. Smak
NEIMAN, CHARLES H., JR., Asst. Dir. of Engrg., York-Shipley, Inc., York, Pa.	A. W. Ruff J. J. Mirabile	E. R. Walsh, Jr. W. E. Zieber
OTTUM, ALVIN L., Htg. & Vent. Engr., Glenn L. Martin-Nebraska Co., Omaha, Nebr. *(Advancement)*	B. G. Peterson G. E. Merwin	E. P. Dempsey D. D. Williams
PARSONS, LAWSON G., Wholesale Plbg. & Htg. Mgr., New York Corrugating Co., York, Pa.	J. J. Mirabile M. F. Blankin	E. R. Walsh, Jr. *C. H. Newman, Jr.

POWERS, ROWAN E., Asst. Gen. Mgr., Sarco Canada, Ltd., Toronto, Ont., Canada.	W. H. Evans V. J. Jenkinson	J. P. Fitzsimons H. R. Roth
PRATS, SIDNEY N., Partner, Sidney N. Prats Sheet Metal Works, New Orleans, La.	C. B. Gamble L. V. Cressy	John Devlin W. H. Dudley, Jr.
RICE, JOHN A., Engr., Charles F. Guyon, Inc., New York, N. Y. *(Reinstatement & Advancement)*	W. A. Sherbrooke G. A. Dornheim	H. S. Johnson H. J. Ryan
ROY, RAUL, Sales Engr., Sarco Canada, Ltd., Toronto, Ont., Canada.	W. H. Evans V. J. Jenkinson	J. P. Fitzsimons H. R. Roth
SALINGER, ROBERT J., Mech. Engr., Reg. F. Taylor, Houston, Texas. *(Reinstatement and Advancement)*	R. F. Taylor D. M. Mills	A. G. Shearer F. C. Brandt
SCHERER, LEO J., Gen. Mgr., Frank Scherer & Son, Denver, Colo.	J. H. McCabe R. W. Akerlow	D. J. McQuaid F. L. Adams
SIMPSON, WALTER B., Div. Mgr., A. M. Byers Co., St. Louis, Mo.	J. J. Blackmore B. C. Simons	B. L. Evans W. J. Oonk
SMITH, GUY F., Sales Engr., The H. B. Smith Co., Inc., Philadelphia, Pa.	M. F. Blankin A. E. Kriebel	H. H. Erickson A. P. Morrow
SPENCER, ROLAND M., Dist. Sales Mgr., The Powers Regulator Co., Chicago, Ill.	C. A. Gustafson A. J. Keating	A. L. Crump E. W. Rietz
STEWART, IRIL A., Mech. Engr., Office of the Service Command Engineer, Fort Douglas, Utah.	J. H. Chesarek E. V. Gritton	D. R. Wilde H. G. Richardson
STILPHEN, NORMAN E., Owner, Stilphen Engineering Co., Sanford, Maine.	W. T. Jones A. C. Bartlett	S. H. Downs W. P. Buchanan
TIGNOR, WILLIAM L., Service Mgr., Roosevelt Oil Service, York, Pa.	J. J. Mirabile E. R. Walsh, Jr.	*C. H. Newman, Jr. *C. A. Bott
WALKER, LEROY S., Owner, Walker & Wilcox Co., Pittsburgh, Pa.	E. C. Smyers L. S. Maehling	Raymond Little E. H. Riesmeyer, Jr.
WEITKAM, WALTER J., SR., Partner & Gen. Mgr., Holzer Sheet Metal Works, New Orleans, La.	C. B. Gamble F. E. Sedgwick	John Devlin L. S. Weil
WHITE, MAXWELL H., Archt., Cleveland, Ohio.	R. H. Cutting L. T. Avery	J. E. Wilhelm Dennis Boggs
WILKINS, EDWIN S., Mgr. & Engr., Air Handling Dept., Wertz Engineering Co., Inc., Reading, Pa.	H. L. Reese H. M. Parent	J. O. Kirkbride K. B. Shelley
ZUMBEHL, LAMBERT E., Sales Engr., Forslund Pump & Machinery Co., Kansas City, Mo.	O. A. Forslund D. M. Allen	L. A. Stephenson Thomas Pellmounter

*Non-member.

Candidates Elected

In the past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8, of the By-Laws, the following list of candidates elected:

MEMBERS

BERGAN, JOHN R., Zone Supvsr., Minneapolis-Honeywell Regulator Co., New York, N. Y. *(Advancement)*

CONNELL, MAURICE H., Sr. Partner, Maurice H. Connell & Assoc., Miami, Fla.

COOK, BENJAMIN F., 1720 Overton Ave., Independence, Mo. *(Reinstatement)*

CRAIG, WILLIAM G., Asst. Sales Mgr., AiResearch Manufacturing Co., Los Angeles, Calif.

DEMPSEY, EDWARD P., Htg. & Vent. Engr., Glenn L. Martin-Nebraska Co., Omaha, Nebr.

GILBOY, WILLIAM O., Engr., Cooney Co., Syracuse, N. Y.

GRUTZMACHER, ROBERT L., Mgr., Space Htg. Div., Natural Gas Equipment, Inc., San Francisco, Calif.

ISLEY, GARNET H., Assoc. Engr., United States Engineer Office, Seattle, Wash.

LINDSTROM, ALVIN L., Cons. Engr., Mortgage Guarantee Bldg., Atlanta, Ga.

LIVAUDAIS, MARCEL, Mech. Engr., Hq. 8th Naval Dist., New Orleans, La.

MARTIN, HENRY L., Div. Hd., Steam Sales & Service, Boston Edison Co., Boston, Mass.

MOSHER, HAROLD A., Mech. Engr., Eastman Kodak Co., Rochester, N. Y.

NEMEC, FRANK L., Mech. Engr., U. S. Engineers, San Francisco, Calif.

QUINBY, LLOYD B., Indus. Engr., Houston Lighting & Power Co., Houston, Texas.

TIMMERMAN, WALTER C., Engr., Straus-Frank Co., Houston, Texas.

WHITNAH, SCOTT, Cons. Engr., Scott Whitnah & Associates, Minneapolis, Minn. *(Reinstatement)*

ASSOCIATE MEMBERS

AIKIN, FRANK W., Pres., Northern Controlled Heat Co., Inc., Watertown, N. Y.

BAKER, EDWARD L., Mgr., Burbidge Coal Co., Salt Lake City, Utah.

BARRY, WILFRED W., Supvsr., Barry Sheet Metal Co., Ltd., Edmonton, Alta., Canada.

BASSEVITCH, ABRAHAM, Bethlehem Steel Corp., Staten Island, N. Y.

BEAUCHAMP, JOHN H., Owner, Heating & Refrigeration Maintenance Co., Houston, Texas.

BOOTH, ROGER W., Chief Engr., The Lennox Furnace Co., Marshalltown, Iowa.

BUGHER, GEORGE A., Owner, Bugher Metal Products Co., Houston, Texas.

COCKMAN, THOMAS E., B. F. Sturtevant Co. of Canada, Montreal, Que., Canada.

COFFEY, GEORGE B., Service Engr., A. M. Byers Co., Chicago, Ill.

COLLINS, GEORGE J., Supt., Barber Plumbing Co., Houston, Texas.

COONEY, JAMES L., Mgr., Cooney Co., Syracuse, N. Y.

CORRIGAN, THOMAS J., Vice-Pres., Corrigan Co., St. Louis, Mo.

COWAN, ARMAND, Pres., Stuart Cooling Corp., New York, N. Y.

EDWARDS, ARTHUR F., Mech. Designer, Department of Public Works, Toronto, Ont., Canada.

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Messages from Members in Service

The Officers of the Society have received some interesting correspondence from members in Service and some extracts from their letters are quoted for the information of their fellow members.

From A. P. Sgambati, Ensign, USNR—While convalescing from injuries received in the Pacific, I find it is a good time to catch up on some of my correspondence. I have seen quite a bit of the Navy as well as the Pacific and must say that I am glad to be back alive in '45.

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From George W. Akers, Captain, USNR—Many thanks for the nice letters from the President and Secretary. Naturally I am gratified by the action of the Society in waiving dues and enclose check for the special service fee covering publications.

I am not following my regular professional duties in heating, ventilating and air conditioning but, during thirty-two months at sea and seven months in a navy yard, I had many contacts with the maintenance and repair of such equipment. Certainly modern closed-up and blacked-out ships could not have done the marvelously efficient job they have done if it had not been for developments in our profession; developments to which the ASHVE has contributed so much basic groundwork.

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From M/Sgt. A. C. Koenig, 113th Engr. Cbt. Bn.—The Nips were more intent on destruction than they were on construction over here (Philippines). They really made a mess of all the important public buildings. With Europe out of the way now, things out here should pick up a little momentum. Trouble is, the real fight in this theater is just now coming up. All up to now has been build-up. However, unless it's held too far from home, I intend to attend the 1946 Semi-Annual Meeting.

•

From David S. Ross, 2nd Lt., Air Corps—At this air depot my first assignment was to the Manufacture and Repair Section of 1200 people and consisting of such shops as machine, tool repair, welding, sheet metal, plating, heat treating, wood and plastic. When the Methods and Procedures Section of the Maintenance Division was formed I was transferred and found that this section compared with the engineering division of many large plants.

The prime purpose of the division covers complete tear down and overhaul of Air Corps equipment from heavy bombers to the smallest spark plug.

Some of the problems encountered here are quite similar to those in major plants, others quite different and very interesting. Industrial exhaust is a major problem, with such items as rubber dust, acid fumes, paint-laden air, metal dust, solvent vapors and many others harassing the workers.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1945 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Pump, Drive, and Motor Maintenance

No. 2822—To facilitate quick, easy reconversion inventories of industry's most widely used general purpose equipment, the Allis-Chalmers Mfg. Co., Milwaukee 1, Wis., has announced that it will soon begin to distribute a newly prepared reconversion inventory kit, covering centrifugal pumps, V-belt drives, and electric motors. Actual condition of this equipment is in many cases unknown in this early period of reconversion.

For about four years, far greater emphasis has been placed throughout industry on setting production records than on keeping maintenance records, according to the announcement. Because much equipment has been worked during wartime three and four times as many hours a year as in peacetime, calendar age may mean nothing. Through necessity, much equipment has been misapplied, and repair has often depended on ingenuity and baling wire.

The kit is intended to enable the user to determine the exact condition of each piece of existing equipment which is scheduled for peacetime production duty. Standards which generally apply to all makes of the same type of equipment determine which units are (1) okay as is, (2) need new parts, (3) will shortly require replacement, (4) need immediate replacement, (5) need reapplication, (6) are obsolete, or (7) may have parts of second or third-choice materials that were dictated by wartime shortages.

This kit, which will be distributed free, contains a set of three fact sheets, one for each type of unit, with suggestions for inventory procedure, and a set of three check lists which summarize the procedures and permit detailed appraisal of each unit.

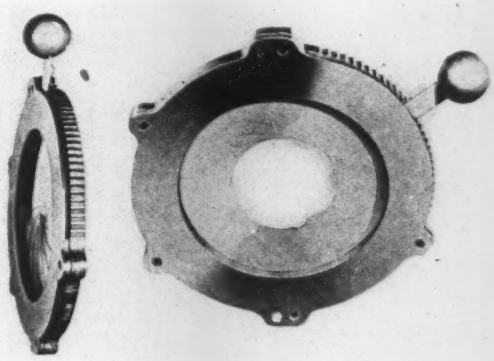
The procedure instructions recommend that a centrifugal pump inventory, for instance, commence by obtaining the history of each pump from master maintenance records and reports from foremen. Step two is to watch the unit in action. Capacity, efficiency, and head; suction lift, alignment of motor and pump shafts; bearing temperatures; degree of leakage at stuffing boxes; and excessive vibration or noise should all be checked.

In step three the pump is disassembled for checking of parts. This includes examination of wearing rings and close-clearing bushings; inspection of impeller; check of the casing; measure of bearing clearances; inspection of sleeves; check of water seal piping; and check of oil rings.

Similar three-step procedures for studying the equipment's history, noting operating characteristics, and inspecting essential parts are included in the new kit to permit comparison of existing V-belt drives and electric motors with known needs for reconversion production.

Heat Control Unit

No. 2823**—A new heat and ventilator control unit known as the "Aero Valve" has been announced by the Smith-Mautz Co., 230 S. Orange, Glendale 4, Calif. It is offered for any air or heat control application, particularly in the marine, air conditioning, and bus transportation fields.



The unit has 36 positive control stages and is designed like a camera shutter, with 15 to 18 shutter segments. The aluminum die cast cover and housing have an anodized finish; all other parts are made of stainless steel. It is available in five model sizes with openings from 2 to 7 in. in diameter.

New Name for Steam Specialties

No. 2824—A major change in the nationwide sales and distribution of its products has been announced by the Clark Mfg. Co., 1830 E. 38th St., Cleveland 14, Ohio.

During the past 37 years, steam and vacuum traps, pressure regulators, separators, and other steam specialties have been manufactured by Clark but marketed under another name. For this reason, the identity of the company itself has been little known in the field, although the products manufactured by it have been widely distributed. A change of policy brings all of

---

Heating, Piping & Air Conditioning, [7-45]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature.

(Circle each number in which you are interested)

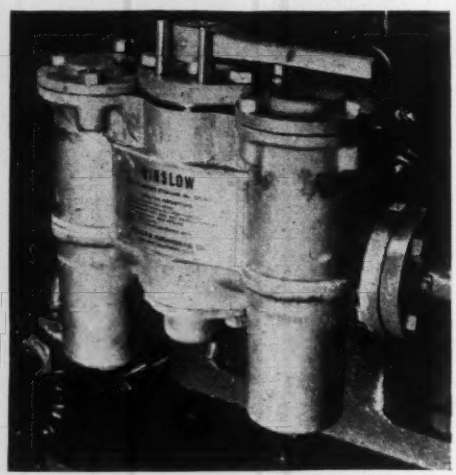
2822 2823 2824 2825 2826 2827 2828 2829 2830 2831
2832 2833 2834 2835 2836 2837 2838 2839 2840 2841
2842 2843 2844 2845
5002 5003 5004 5005 5006 5007 5008 5009 5010 5011
5012

Name ..... Title.....
Company .....
Address .....
City..... Zone..... State.....

the activities of product designing, engineering, manufacturing, sales and distribution under one roof. From now on the company's products will be sold as "Clark Fluid Controls."

Magnetic Type Strainer

No. 2825**—The Winslow Engineering Co., Oakland, Calif., has announced a new magnetic type strainer for use in lubricating oil lines of steam turbines or other power equipment to remove filings and metal particles through the combination of magnetic action and screening. The strainer combines in one unit the bypass valves, pressure regulator, main control valve, and the two strainer elements in which magnets are located. A quick acting, hand operated, three way, control valve permits the change of flow from one strainer element to the other, or through both elements. Adjacent to this valve is the pressure regulating valve, for adjustment of outgoing oil pressure.



The strainer is of either cast bronze or iron for the one piece body which incorporates the manifold, the strainers, inlet and outlet connections. The two cylindrical baskets are constructed around a main body of perforated steel, within which are fine wire mesh linings. The magnets are suspended within the baskets.

In the body is a spring loaded bypass valve that may be adjusted from the outside. This model is designed to handle 15 gpm. A larger model to handle 40 gpm is also available. Where finer filtration of the lubricating oil is necessary, cartridge type oil conditioners may be used in conjunction with the strainer.

Industrial Balancing Film

No. 2826—A 20 min. sound slide film, produced by the Bear Mfg. Co., Industrial Div., Rock Island, Ill., shows how every wheel, armature, fan blower, flywheel, and shaft—everything that turns—is a potential source of high costs in maintenance, repair, and operation because of unnecessary wear caused by dynamic and static unbalance. Industrial balancing machines that are said to correctly balance any rotating part from a 4 oz body used in a fractional horsepower motor to a 4000 lb turbine wheel are demonstrated in this film, which is being made available by the manufacturer through its field engineers located in various key cities.

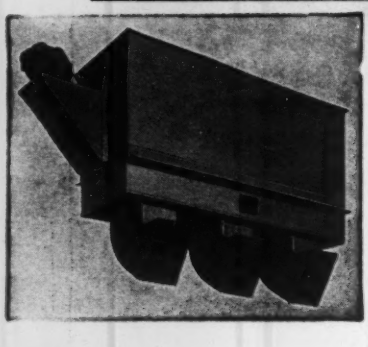
Employees Manage Vilter Co.

No. 2827—Control and management of the Vilter

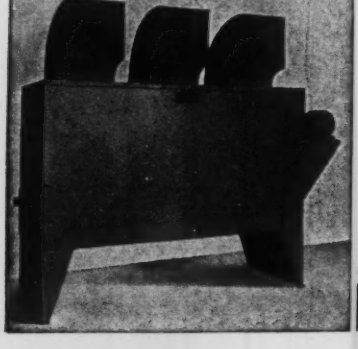
Available for Prompt Delivery—

THE AIRTHERM CENTRIFUGAL FAN TYPE, STEAM UNIT HEATER

(Vertical, Horizontal, or Floor Type Models)



Ceiling mounted, inverted type.



Floor mounted.

The Airtherm centrifugal, fan type, steam unit heater is a highly efficient heater for either vertical or horizontal suspension and is available to you for delivery during the present heating season.

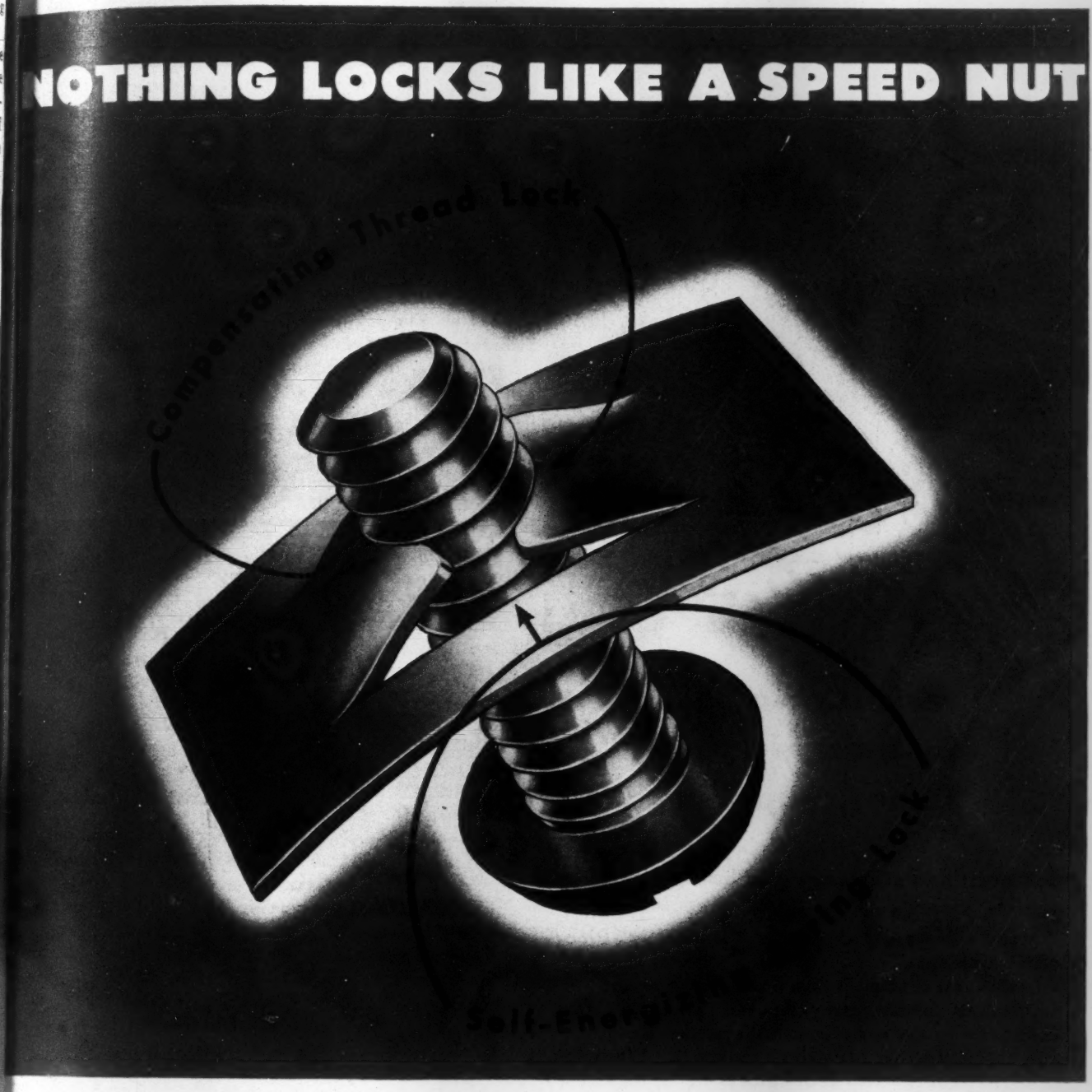
This high velocity unit insures uniform temperature distribution and maximum heat flow effecting savings in both fuel and maintenance cost. Capacities range from 200,000 to 825,000 B.T.U.

Send us your specifications or write for the Airtherm Catalog today. Our engineers will gladly work with you in planning efficient heat for your plant.

AIRTHERM MANUFACTURING COMPANY

711 South Spring Avenue • St. Louis 10, Missouri

NOTHING LOCKS LIKE A SPEED NUT



SPEED NUTS are the only fastening devices that provide a COMPENSATING thread lock and a SELF-ENERGIZING spring lock. TWO distinct forces are exerted on the screw, as the SPEED NUT is tightened.

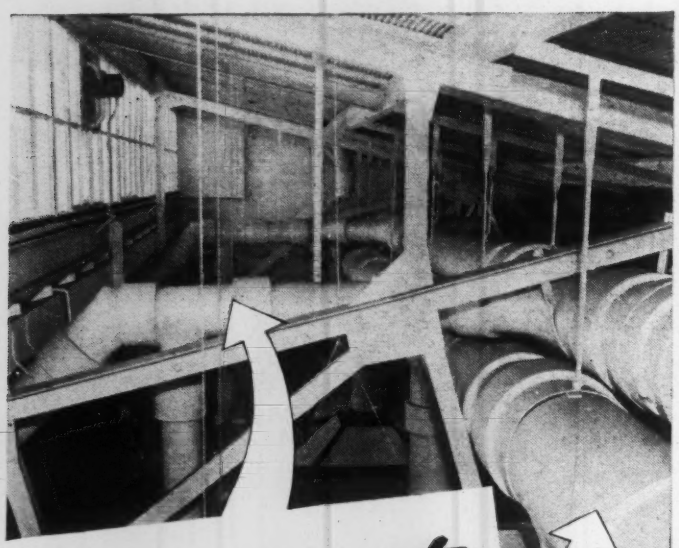
First, a compensating thread lock, the two arched prongs moving inward to engage and lock against the root of the screw thread. These free-acting prongs compensate for tolerance variations, and function perfectly on oversize or undersize screw or bolt threads.

Second, a self-energizing spring lock, created by the compression of the arch in both the prongs and base. The combined forces of the thread lock and spring lock definitely eliminate vibration loosening.

SPEED NUTS, proven in pre-war commercial industry and now boosting the production of airplanes, are ready to assist you in the assembly of post-war metal, vitreous enamel, plastic or wood products. Literature is available on over 3000 shapes and sizes, for standard or special assemblies.

TINNERMAN PRODUCTS INC.
2018 Fulton Road **Cleveland 13, Ohio**

Speed Nuts PATENTED *Trade Mark Reg. U. S. Pat. Off.



These Ducts defy Rust...

resist Corrosion by many industrial fumes, vapors, gases

Do rust and corrosion play havoc with your venting system?

Many users are finding that Transite "S" Pipe offers a practical answer to this problem. Made of asbestos and cement, it is completely rustproof . . . successfully resists many types of corrosion encountered in industrial venting systems. Rotproof and highly weather resistant, Transite "S" Pipe can be used either indoors or outdoors—for ducts, vents and stacks—without painting or other surface protection.

Installations such as the one shown present no problem because Transite "S" Pipe is light in weight, easily assembled, and comes in a range of 19 sizes—diameters from 2″ up to 36″. A complete line of fittings is also available.

For full information on Transite "S" Pipe, write for data sheets DS Series 336. Address Johns-Manville, 22 East 40th Street, New York 16, New York.

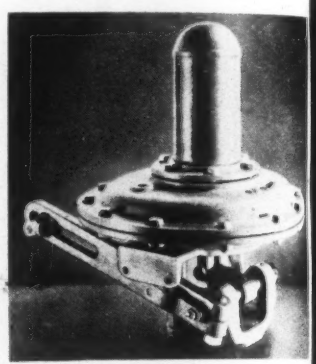
JM PRODUCTS

Johns-Manville TRANSITE 'S' PIPE

Mfg. Co., 2148 S. First St., Milwaukee 7, Wis., has passed to a group of employee executives, the company announced recently. The new officers are E. B. Tilton, president, treasurer, and general manager; A. A. Silverman, vice-president; L. E. Loos, secretary; and M. F. Grady, assistant secretary and assistant treasurer. The company is completely independent and will be operated under a board of directors of employees. Articles of incorporation have been amended so that the company is now a non-stock corporation. Net profits of the company will be used primarily for scientific research, for the benefit of employees, for rehabilitation of war veterans, and for educational purposes. Under the new management the company will continue to manufacture its usual industrial and commercial refrigerating and air conditioning products, with new developed items being added from time to time.

Pneumatic Diaphragm Motor

No. 2828**—Conoflow Corp., 2100 Arch St. Philadelphia 3, Pa., has recently introduced the "Cono" model V pneumatic diaphragm motor for use in conjunction with throttling type industrial control instruments to operate rotary stem valves, butterfly valves, or other control devices requiring long travels of the power lever. It features an outboard type of operating lever, permitting mounting of the motor directly over the valve body. This lever can be clamped in any position within a 200 deg arc of travel, it is said, and an additional lever can be supplied for the opposite end of the shaft to operate another valve or control device simultaneously.



The manufacturer points out that when used with a pneumatic valve positioner, this device is capable of operating butterfly valves, gas valves, and others in which static pressures and differential pressures are relatively low, 8 or 10 in. or longer. The standard unit has a nominal spring range from 2 to 14 lb.

Glass Fibers Insulate Air Transport

No. 2829—A ½ in. thick lining of interlaced glass fibers with an average diameter of 0.00005 in. provides heat and sound insulation in the AAF's Boeing C97 troop and cargo transport, according to the Owens-Corning Fiberglas Corp., Toledo, Ohio, manufacturer of the insulation. The C97 is a military prototype of the Boeing Stratocruiser, a postwar, double deck luxury transport plane which will be capable of carrying 72 to 100 passengers over an operating range of 3500 miles.

During a 16 hr. cold test, the increase in weight due to condensation of moisture within the insulation was negligible and weight had returned to normal by the next day. Flight tests showed that the insulation held sound well below the stipulated upper limit for the plane. Additional tests demonstrated the lining's incombustibility and freedom from tendency to rot. Air-

What has Star got?

Before you pick any motor to power your postwar product we'd like to submit 3 teasers . . .

(". . . and I know 'em all!")

Why did a famous maker of Materials Handling Equipment* not long ago say — "There isn't a Brake Motor built that can touch that Star, and I know 'em all"?

(". . . you like 'em tough")

Why did one of the world's biggest makers of Machine Tools* recently choose Star to work with on a tough application problem?

(". . . laying it in your lap")

Why did a noted Dairy Machinery company* pick Star to develop a unique small Generator for their new machine?

*(*Name on request)*

We needn't tell you that buyers like these three are motor-wise, and hard-boiled in their determination to obtain the most satisfactory solution to powering their products. . . .

And we needn't tell you that we have engineering brains second to none, or that we have excellent production facilities. Without them, we could not get to first base. . . .

What, then, is the "something extra on the ball" we *must* have to lead such concerns to choose to work with Star on their new products?

You'll find it's Star's approach to a motor problem – a willingness to give your job "top billing". There's no stop-watch on the brains applied to your problem – and there are not so many problems that we can't apply our best brains to all.

That's why you, too, will choose wisely by making Star your postwar "Motor Department". Our designing facilities can be placed at your command NOW, to solve any problems not covered by standard Star Motors, from 1/8 to 200 HP, some of which are available for early delivery. Star Electric Motor Co., 200 Bloomfield Ave., Bloomfield, N. J.

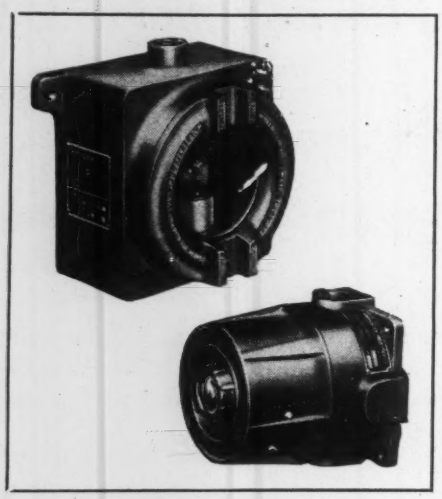
STAR MOTORS

POWER PACKAGED AS YOU NEED IT

proximately 7000 sq ft of the lining, with a total weight of 182 lb., are installed in the C97. The lining is formed by bonding the fibers with a thermosetting resin and covering the interlaced mass of fibers with an incombustible fabric.

Photoelectric Smoke Detector

No. 2830—Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass., has recently announced a photoelectric system to detect the presence of smoke in air conditioning ducts and to sound alarms, turn off blowers, operate automatic dampers, or provide whatever other type of indication or control is required.



The system consists of a photoelectric control and a light source. The latter may be mounted to project a beam of light over any distance from 10 to 25 ft to the eye of the photoelectric unit. A sensitivity adjustment on the light source housing permits variation in the intensity of the light beam and may be set so that the photoelectric control will respond to smoke of a predetermined density. The photoelectric unit will then remain inoperative at any other level of illumination, it is said, but will be actuated when smoke haze sufficiently reduces the amount of light reaching the phototube. The unit is so designed that either current or tube failure will cause the control to fail to operate as though the light beam were interrupted.

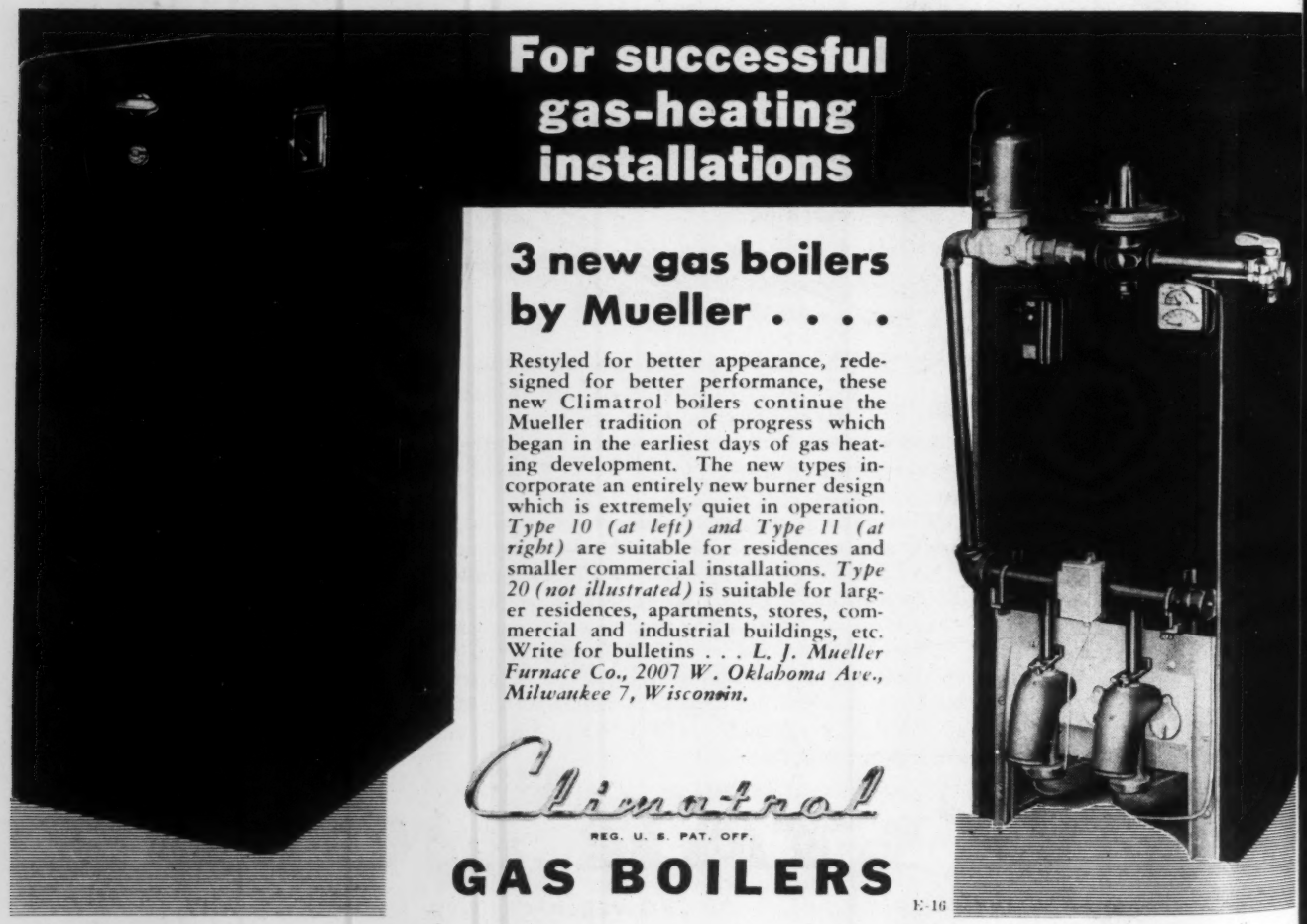
Eureka and Williams Merge

No. 2831—The Williams Oil-O-Matic Heating Corp. and the Eureka Vacuum Cleaner Co. have recently merged in accordance with a plan approved by the shareholders of both companies. Both companies will continue with entirely separate, independent sales and merchandising operations. Product trademarks will also be carried as before. The Williams company is now known as the Williams Oil-O-Matic Div. of the Eureka Vacuum Cleaner Co.

W. A. Matheson, president of Williams, now is a vice president and director of the Eureka company and manager of the Williams Oil-O-Matic Div. Henry W. Burritt, Eureka president, becomes president of the merged companies. All officers and directors of Williams continue with the company, except Walter W. Williams, who disposed of his entire interest to Eureka.

"Radiant Walls" in Stratoliners

No. 2832—Stratoliners returned to TWA, Inc., and


For successful gas-heating installations
3 new gas boilers by Mueller . . . .
Restyled for better appearance, redesigned for better performance, these new Climatrol boilers continue the Mueller tradition of progress which began in the earliest days of gas heating development. The new types incorporate an entirely new burner design which is extremely quiet in operation. Type 10 (at left) and Type 11 (at right) are suitable for residences and smaller commercial installations. Type 20 (not illustrated) is suitable for larger residences, apartments, stores, commercial and industrial buildings, etc. Write for bulletins . . . L. J. Mueller Furnace Co., 2007 W. Oklahoma Ave., Milwaukee 7, Wisconsin.
Climatrol
REG. U. S. PAT. OFF.
GAS BOILERS
E-16

REPUBLIC
- the Preferred Pipe for Commercial Buildings

Social Security Building, Washington, D. C.; Public Buildings Administration, Federal Works Agency, Architect; McClaskey & Co., General Contractor; Mehring and Hanson, Plumbing and Heating Contractors.

● For heating, plumbing, air conditioning installations and other types of piping work, you can specify Republic Steel Pipe—*with confidence.*

Uniformly ductile throughout, Republic Steel Pipe coils and bends easily—its strong, tight weld readily resists the most severe type of pipe fabrication.

Moreover, because it is made by the improved continuous weld process, it is free from corrosion-inviting scale, inside and out. It cuts and threads quickly and cleanly—and, when used without threaded fittings, welds easily by all modern methods.

Available in uniform lengths—extra long if you need them—Republic Pipe goes in fast—saves time, money and material on every job.

See your local Republic Pipe Jobber for full information on sizes available and delivery schedules; or write directly to:

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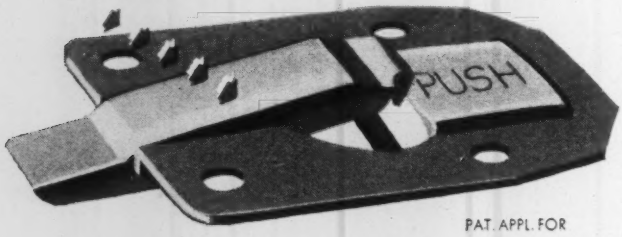
Republic
STEEL PIPE

Pipe is only one of a wide line of Republic Steel Building Products. See Sweet's for details.

CUT MAINTENANCE TIME WITH THE NEW HARTWELL FLUSH DOOR LATCH



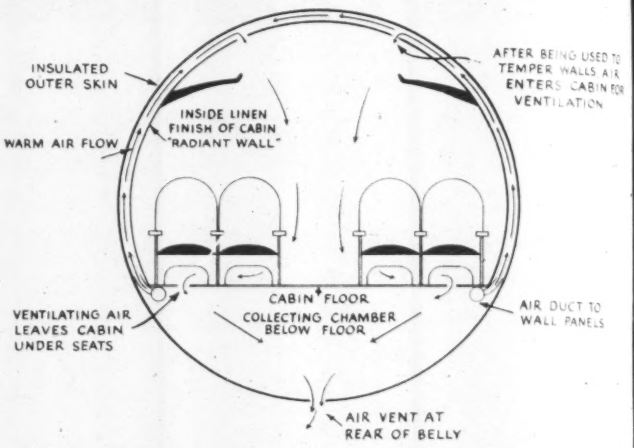
PAT. APPL. FOR

Designed for use on combat planes, the Hartwell *flush* latch speeds the opening and closing of access doors. It can be used on metal, plastic or wood, and on doors of varying sizes and thicknesses. It can also be used on cover plates, cabinet and locker doors and flush fixtures. The Hartwell *flush* latch is made of stainless steel, and can be supplied unmounted or spotwelded to an installation plate.

For detailed information about uses and adaptations of the new Hartwell *flush* latch, write: Engineering Department, Hartwell Engineering Company.

HARTWELL
ENGINEERING COMPANY
Designers • Manufacturers • Distributors
3417 Crenshaw Boulevard, Los Angeles 16, California
Dallas, Texas • Kansas City, Kansas

improved for commercial service feature a radiant wall" heating system. The principle is to circulate warmed air between the insulated inner surface of the skin of the airplane and the linen interior finish walls of the cabin. Exact and continuous control of the circulated air in flight and on the ground is possible because of the combustion type heaters which operate independently of the plane's engines, says Surface Combustion, 2375 Dorr St., Toledo 1, Ohio, manufacturer of the heaters.


INSULATED OUTER SKIN
AFTER BEING USED TO TEMPER WALLS AIR ENTERS CABIN FOR VENTILATION
INSIDE LINEN FINISH OF CABIN "RADIANT WALL"
WARM AIR FLOW
CABIN FLOOR
COLLECTING CHAMBER BELOW FLOOR
VENTILATING AIR LEAVES CABIN UNDER SEATS
AIR DUCT TO WALL PANELS
AIR VENT AT REAR OF BELLY

A heating package fits into the belly of the plane by dropping a quick access panel. The package includes two aircraft heaters of 100,000 Btu capacity each and is complete with all thermostatic controls, fuel pumps, combustion air blower, necessary dampers, and other devices for automatic operation. In flight one of the twin heaters is normally sufficient to warm the airplane, it is said, so if there should be one heater failure there would still be adequate heat. TWA reports that in over 1000 hr of flight in the first improved Stratoliner there have been no failures or special maintenance work on the heaters.

In operation, the two heaters are continuously cycled on and off under automatic control. At no time is the surface temperature of the "radiant walls" in excess of the design temperature of 90 F. Fresh warmed air and cold air are blended for cabin circulation by a thermostat control. Fresh air is always moving gently through the cabin whether or not heat is required. Two air intakes at the leading edges, one in either wing, bring air under ram pressure to the heaters when the plane is in flight.

One inch diameter outlets at 16 in. intervals along the duct under the cabin floor line force air up back of cabin walls between the rings. This air also travels between the panes of the double windows.

New Pulsation Damping Unit

No. 2833—The measurement of pressure and flow can become quite difficult when changes occur in rhythmic fashion, particularly when they are of an oscillatory nature and possess amplitudes which are equal to or exceed one per cent of full scale range. Under such conditions chart records and control settings may deviate considerably from the ideal. To effect the removal of pressure waves, the Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y., have developed a new type of pulsation damping unit. This unit, the manufacturer says, is universal in application, non-

Tubing Topics . . .

PROGRESS REPORT ABOUT "WELD-ON" FINNED TUBING AND TILCO FIN

NO 1

by EXTENDED SURFACE

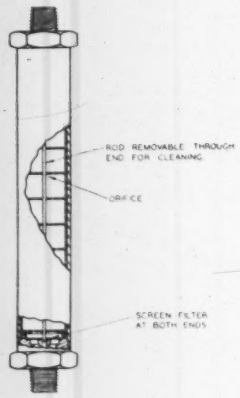
Division of DAVID E. KENNEDY, INC. 68 Second Ave., Brooklyn 15, N.Y.

New plant facilities and new equipment now make possible greater production of Tilco Fin. Some further reductions in cost also achieved because we specialize only in finned tubing in straight lengths. Inherent economy of Tilco Fin design, due to high performance characteristics, proved by many operating installations. Tilco Fin's helically wound segmented fin design makes possible coils with more BTU's per dollar per cubic foot of space occupied. High heat transfer allows cross flow coil design of maximum compactness. Low resistance allows greater depth of coil without increased static. Result: smaller ducts, smaller fans, less power. Ferrous and some non-ferrous tubes now being welded—making fins virtually extended parts of tube. Send for interesting details of laboratory test work and record of years of commercial use. And benefit by the attention of a finned tube specialist whose only interest is to produce the most efficient type of surface at the lowest possible cost.

TILCO-FIN EXTENDED SURFACE TUBING FOR Dual Efficiency

adjustable, and delivers an output pressure which is essentially equal to the average flow of the pulsating input pressure.

It consists of a series of alternate small capacities or volumes and orifices. As the pressure wave enters the device a differential occurs across the first orifice which causes a flow through it, thus raising the pressure in the adjacent chamber. This in turn causes a flow through the next orifice, producing similar effects except with decreased intensity. While this "above average" value of the pressure wave is making its way through the series of chambers, the pressure drops below the average value (since it is a pulsating one) causing a reversal of the flow process. Thus it is said that the various capacities "breathe" with decreasing intensity as the waves pass through the damping unit until finally a point is reached where the pressure level lies just about at its average value.



To overcome the difficulty of plugging, fine mesh screens are provided at both the entrance and exit of the damping unit. A rod which passes axially through the series of orifices can be removed, thus exposing a large orifice area for cleaning. The unit bears a working pressure rating of 1500 psi.

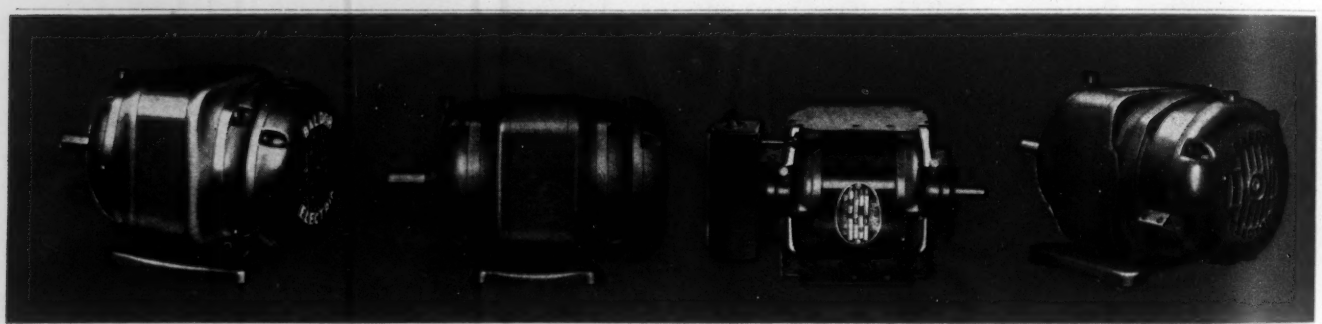
Snap Action Control Devices

No. 2834—A line of devices which embody a snap action arrangement for control of temperature, pressure, humidity, and mechanical displacement has been announced by the Thermal Div., Paul Henry Co., 2037 S. La Cienega Blvd., Los Angeles 34, Calif. Known as "Cam-Stat" temperature controls, the applicable range of these devices is said to be from minus 100 to plus 600 F. Types are single pole single throw, single pole double throw, and independent circuit double throw. Contact openings are from 0.010 to 0.060 in. According to the manufacturer, these controls are tamper proof, resistant to vibration, and have low thermal lag.

The thermostat illustrated weighs less than 1 oz and is rated at 10 amp, 115 volt a-c or 28 volt d-c.

Waterproofing Liquid for Motors

No. 2835**—A waterproofing liquid for electric motors, ignition systems, batteries, internal combustion motors, wiring, and other devices affected by water or moisture has recently been made available for civilian use, according to the manufacturer, U. S. Industrial Chemicals, Inc. This liquid insulation product, which is known as "PiB," has been widely used by the armed forces for waterproofing ignitions and preventing battery corrosion of jeeps and amphibious vehicles.

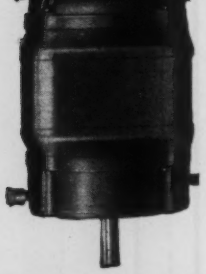


BALDOR glass-insulated motors are used for all applications; especially recommended where limited space and weight is a factor.

BALDOR totally enclosed motors, STREAMCOOLED DESIGN, available in 1 ph., 3 ph. and D. C.

BALDOR fan and blower motors, gimbal-mounted, assure Quiet Operation.

Fully compensated D. C. motors; available in standard and low voltage for truck, railway and traction service.



BALDOR face-mounted vertical motors; totally enclosed STREAMCOOLED DESIGN; 1 ph., 3 ph. and D. C.

BALDOR

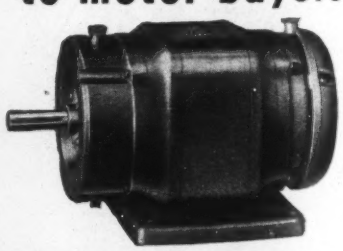
BETTER MOTORS

Regardless of mechanical specifications and current characteristics required, Baldor is qualified by experience to handle your motor problems. The complete Baldor line includes all types of motors 1/20 to 20 H. P.

BALDOR ELECTRIC COMPANY, ST. LOUIS 10, MO.

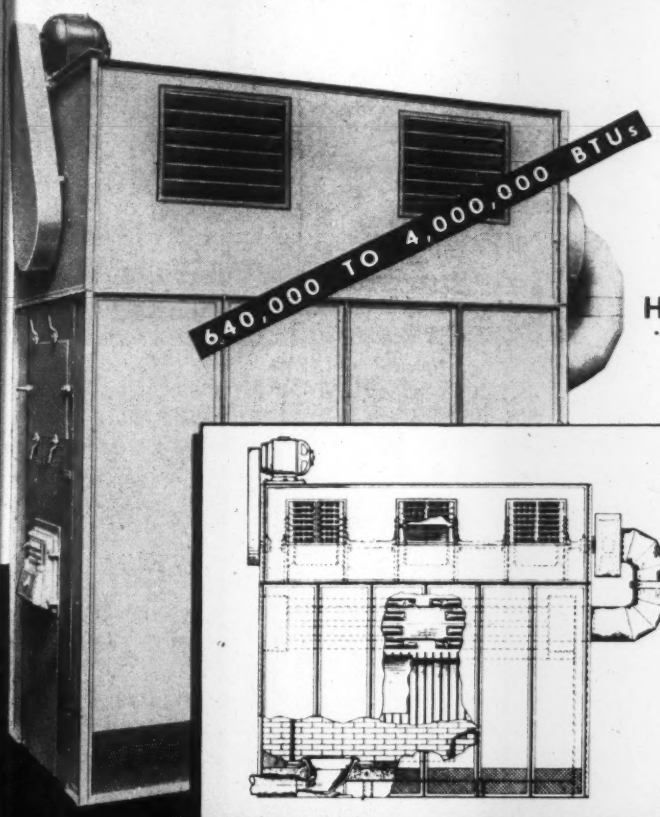
District Offices in Principal Cities

25th YEAR of engineering service to motor buyers



BALDOR face-mounted horizontal motors; totally enclosed, STREAMCOOLED DESIGN; 1 ph., 3 ph. and D. C.

NATIONAL CHAMPION



OIL
GAS
STOKER
HAND FIRED

TIME PROVEN HEATING UNITS ★

STEEL S-P-A-C-E HEATERS

ENGINEERING RATING CHART

HEATER NUMBER	B.T.U. OUTPUT CAPACITY	½" S.P. C.F.M. MAX.	GRATE AREA SQ.FT.	SQ.FT. HEATING SURFACE	VOLUME CU.FT. INSIDE HEATER	BLOWER MAXIMUM	BLOWER MOTOR H.P. MAX.	BLOWER MOTOR R.P.M.	TUBES NO.	TUBES DIA.	APPROXIMATE WEIGHT LESS STOKER
300	640,000	8,200	6.5	320	75	18"TWIN	3	1750	2	8"	8,850
350	860,000	11,000	8.0	430	100	18"TWIN	5	1750	2	8"	14,420
500	1,215,000	18,150	12.0	600	130	21"TWIN	7.5	1750	10	4"	15,860
550	2,000,000	32,000	14.7	844	175	21"TRIPLE	10	1750	12	4"	18,610
600	2,500,000	45,000	16.0	1421	315	27"TRIPLE	15	1750	16	4"	20,850
650	3,000,000	52,000	20.0	1685	375	30"TRIPLE	20	1750	16	4"	24,090
700	3,500,000	56,000	24.0	1810	450	30"TRIPLE	25	1750	18	4"	26,340
750	4,000,000	60,000	28.00	1935	450	30"TRIPLE	30	1750	20	4"	28,470

FEATURES

SELF-CONTAINED UNIT
•
BOILER PLATE CONSTRUCTION
•
DEPENDABLE AUTOMATIC CONTROL OF HEAT AND AIR
•
INDUCED DRAFT BLOWER
•
FACTORY TESTED AND ASSEMBLED
•
DIRECT HEAT TRANSFER
•
GREATER FUEL SAVING
•
LOW COST OPERATION
•
AMPLE AIR PASSAGE CAPACITY
•
LOW STATIC RESISTANCE
•
LOW STACK TEMPERATURE
•
SIMPLE AND CONVENIENT INSTALLATION
•
MINIMUM FLOOR SPACE REQUIRED
•
FLEXIBILITY FOR LOCATION
•
BUILT FOR YEARS OF DEPENDABLE PERFORMANCE
•

AIR-CONDITIONING, HEATING, DRYING & DEHYDRATING

WRITE FOR FULL INFORMATION.

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ESSEX BUILDING ★ ★ ★ MINNEAPOLIS 2, MINN.

and more

FREEMAN

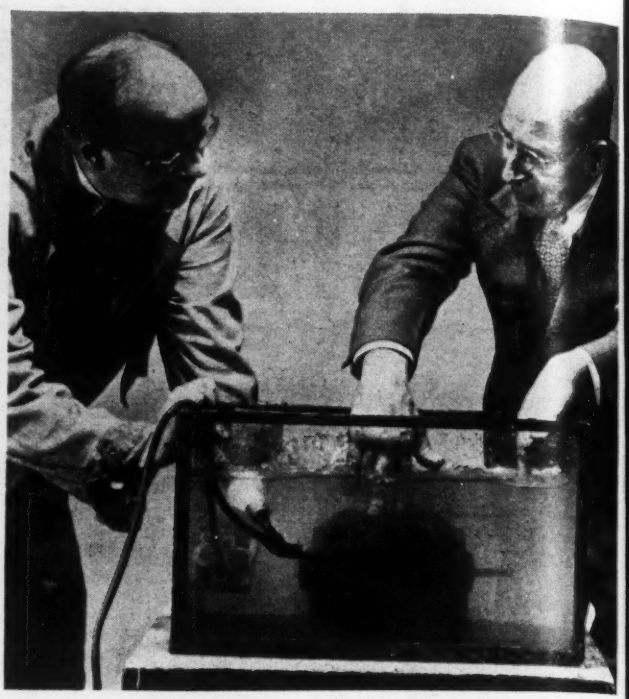
LONG-LIFE STOKERS

FIRST CHOICE OF AMERICA'S FOREMOST HEATING ENGINEERS

...A COMPLETE LINE...A SUCCESS-PROVED PROMOTION PROGRAM ...THE SECURITY OF A DEPEND-ABLE, FINANCIALLY STRONG MANUFACTURER WHO WILL ALWAYS BE IN THE STOKER BUSINESS TO SERVE YOU!

PIONEER OF THE STOKER INDUSTRY . . . ONE OF THE LEADERS IN NATIONAL SALES VOLUME!
COMPLETE RANGE OF SIZES UP TO 1200 POUNDS PER HOUR

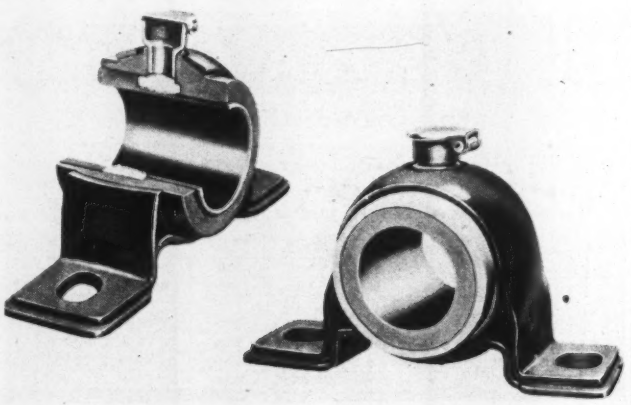
FREEMAN STOKER DIVISION
ILLINOIS IRON & BOLT CO.
918 S. MICHIGAN AVE., CHICAGO 5, ILLINOIS



Photograph shows a ½ hp electric motor and exposed light bulb, previously coated with the waterproofing liquid, which have operated continuously for over two years while completely submerged in an aquarium tank.

Bronze Bearing

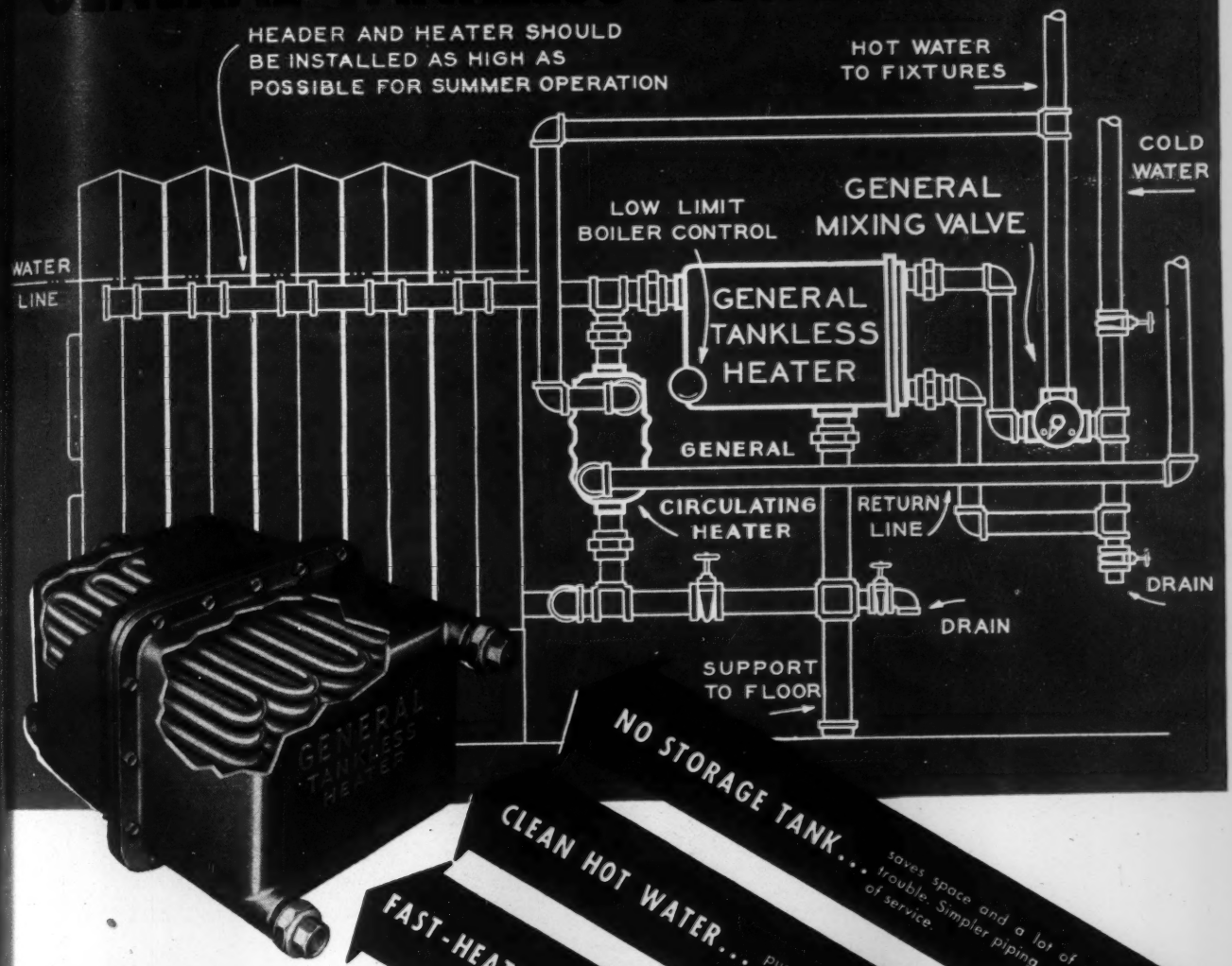
No. 2836—Especially adapted for fan and blower service is the type F "Bronzoil" bearing, according to a recent announcement of the Dodge Mfg. Corp., 500 S. Union St., Mishawaka, Ind. The bearing is self aligning, the manufacturer says, the inner housing being spherical to conform to a spherical socket in the formed



steel outer housing which permits free self alignment and avoids cramping the shaft. A bronze capillary bushing which carries about ⅓ of its volume of lubricant is used as a liner. This bushing is provided with a shoulder which offers a broad, flat bronze bearing surface which tends to reduce friction between the bearing and the collar which positions the shaft. An oil reservoir with a close fitting wick surrounds the bronze capillary bushings and supplies the required amount of oil as needed.

The most inexpensive way to get HOT WATER is the best way to build postwar business

GENERAL TANKLESS WATER HEATERS



NO STORAGE TANK... saves space and a lot of maintenance trouble. Simpler piping. No interruption of service.

CLEAN HOT WATER... pure as drinking water: from seamless copper tubing. No sediment or rust.

FAST-HEATING... efficiency due to counter-flow of boiler water from top down and domestic water from bottom up.

Capacity of *GENERAL* TANKLESS HEATERS: 3½ to 70 g.p.m., for every need, from a bath to an industrial process. Until Victory . . . a major part of our production is precision war work . . . torpedo and bomb parts, fuse setters, special Navy water heaters. Meanwhile, send for Catalog No. 16. General Fittings Co., Dept. A, 123 Georgia Avenue, Providence, Rhode Island.

GENERAL

TANKLESS WATER HEATERS

Magnetic Reversing Starter

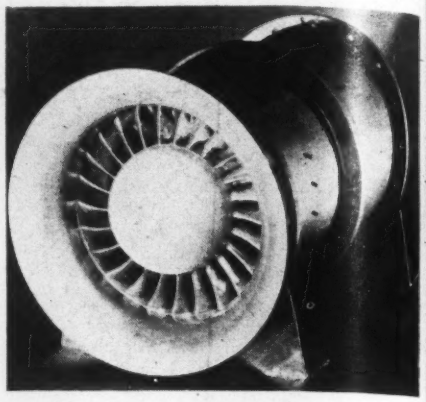
No. 2837—A new a-c magnetic reversing starter, featuring a semi-interference type mechanical interlock, has been announced by the Industrial Control Div. of the General Electric Co., 1 River Rd., Schenectady 5, N. Y. Available in sizes 0 and 1, the starter is designed for full voltage starting of squirrel cage induction motors and can be used for reversing service when combined with a reduced voltage starter. The semi-interference mechanical interlock prevents the closing of one contactor while an arc is maintained on the other, thus averting a short circuit through the arc. In addition, the interlock arm of the closing contactor assists the interlock arm of the opening contactor in reaching its fully opened position. These interlock arms are case-hardened and their underside faces are buffed and polished. The starter is housed in a metal enclosure 9⅞x13⅝x4 9/16 in., equipped with a hook-on cover.

Boiler Cleaner

No. 2838**—"Heatrex" boiler cleaner has been made available for national sales, according to an announcement from the Whiting Stoker Sales Co., 11 S. LaSalle St., Chicago 11, Ill. This product is said to correct foaming and priming; to dissolve oil, grease, rust, and heat-resisting substances; and to prevent scale formation, pitting and corrosion of boiler surfaces and piping.

Axial Flow Compressors and Blowers

No. 2839**—Small size, high capacity motors make possible savings up to 30 per cent in the weight of its new line of axial flow compressors, blowers, and fans, says the Buffalo Turbine Co., 2165 Bailey Ave., Buffalo 11, N. Y., in announcing the line recently. Typical is the 14 in. diameter blower shown, which delivers 8000 cfm and 10 in. SP, turning 3450 rpm.



The line is to include a wide range of direct driven units with air pressures from ⅜ to 100 in. of water at synchronous motor speeds; direct connected turbine driven units up to 100 psi and 100,000 cfm will also be available. According to the manufacturer, these units have wide applications in the heating, ventilating, and air conditioning fields requiring pressures up to 6 in. of water; in dust removal, conveying, processing, drying, and forced draft blowers requiring 10 to 100 in. of water; and in coke ovens, blast furnaces, and processing requiring 3 to 100 psi. The manufacturer adds that these units are designed so that they can be installed in accordance with the requirements of conventional duct systems, floor, ceiling, or wall mounted, or they can be suspended in the duct.

Our future line will be W-I-D-E . . . new models and items we have not made before . . . *heating* field *as well as plumbing*,. (See above.) Will include these items taken over from other companies just before the war: Gate Valves, Radiator Valves, and Air and Vacuum Valves. But no one knows when postwar will begin . . . or just how long it will be until "normalcy." So we are stating here what our general plan of operation will be from now until "normalcy."

RECONVERSION POLICY—We plan at all times to resume or add items only as they can be offered on a satisfactory delivery basis—and be a quality product. This will mean starting with very few items, and adding others only as *they also* could be offered with good service.

That is the way we can do everyone the most good so long as scarcities remain—producing the *most* volume possible as *quickly* as possible. And that is best served by a big job with fewer items, rather than less volume of more items.

FOR THE PRESENT—Resumption of some plumbing production is now in sight for our plant. But we are still laden with heavy war-production obligations that leave very limited capacity for plumbing. So for the present we plan to devote all the plumbing capacity (that will be available soon) to sink faucets and strainers. We will get those items on a satisfactory delivery basis first.

LATER RECONVERSION—Beyond the above "first phase" of reconversion, the exact timing of subsequent developments is subject to many unpredictable conditions beyond our control. So instead of guessing at it now, our customers will be kept informed as our ability to serve improves . . . as each item is added to production. And again we thank our customers and other friends for their continued understanding and patience—until that glorious time when special patience and understanding will no longer be necessary.

The Schaible Company · Cincinnati 4, Ohio

MAKERS OF QUALITY BRASS GOODS STOCKED BY LEADING WHOLESALERS EVERYWHERE

3 "F&E" STOKERS HEAT 21 BUILDINGS WITH 420 APARTMENTS!

Somerset Court Homes, Housing Authority of Baltimore City consists of 21 buildings, comprising 420 apartments of from one to four bedrooms.

Architects
D. K. Este Fisher, Jr., and Associates

Engineers
Henry Adams, Inc.

Interior of Somerset Court Homes heating plant, second basement level, showing the 3 "F & E" Stokers, [illegible] connected with three 173 HP Steel Firebox Boilers. For two winters these 3 "F & E" Stokers have continually supplied all winter heat and daily hot water throughout each year to 420 apartments, at a cost of only $56.92 for ordinary repairs and replacements, or about ½ of 1% per annum.

In the Somerset Court installation, "F & E" Underfeed Stokers have again proved their ability to satisfactorily handle the fuel burning requirements of central heating plants. Efficient and dependable, yet flexible, firing equipment is needed the year 'round by Housing Projects such as Somerset Court. That "F & E" Stokers possess the positive heating advantages to meet such requirements in full, is due to the "F & E" combination of advanced engineering features, such as—

Unit type electro hydraulic drive
Interval timer governor coal feed control
Synchronized coal feed and air regulation
Moving retort bottom for proper coal distribution
Quickly adjustable fuel bed regulator
Specially designed high efficiency tuyeres

Call in your local Flynn & Emrich Co. representative and know why hundreds of installations in apartment and business buildings are proving "F & E" Stoker dependability under the most exacting heating requirements.

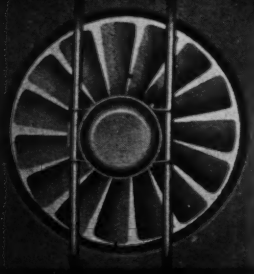
F&E

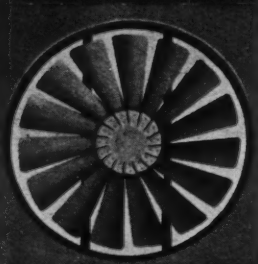
FLYNN & EMRICH CO.
Established 1849

FOR FAST, QUIET AIR MOVEMENT INSTALL

Peerless Electric

PROPELLER FANS

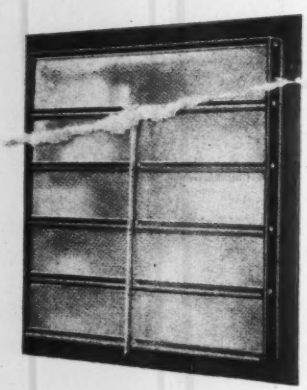




NO matter what your need for quiet, variable speed, attractively designed fans, you'll find the answer in a Peerless Electric design.

A combination of specially engineered capacitor motors and perfectly balanced extra wide blades produces extremely quiet operation. Motors are totally enclosed and permit installation in either a vertical or horizontal position.

These fans are supplied in single-speed, two-speed or three-speed operation and finished in gray. Recommended for stores, restaurants, hotels, offices and similar installations where quietness of operation and attractive appearance are prime requisites. Write for descriptive folders.



Automatic Louvers

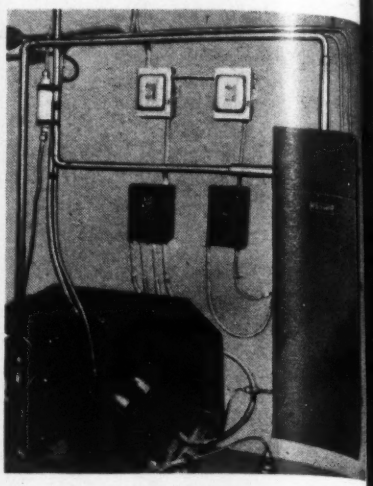
Peerless Electric automatic louvers are designed especially for use with propeller fans. When the fan starts, the air stream instantly opens the louvers, which close by gravity when the fan stops. Completely weather-stripped around the inner edge of the frame. Built of high grade aluminum. Sizes from 10 to 48 inches.

For production achievement

THE Peerless Electric COMPANY
WARREN, OHIO
Established 1893

Self Defrosting Refrigeration Unit

No. 2840—Kramer Trenton Co., 626 Brunswick Ave., Trenton 5, N. J., has introduced the "Thermobank," automatic refrigeration system which is self defrosting without the use of lamps, heaters, or brine spray. This unit, which is a heat exchanger in combination with a "heat hold" (antifreeze solution), holds or "banks" a quantity of heat which is available for the defrost operation.

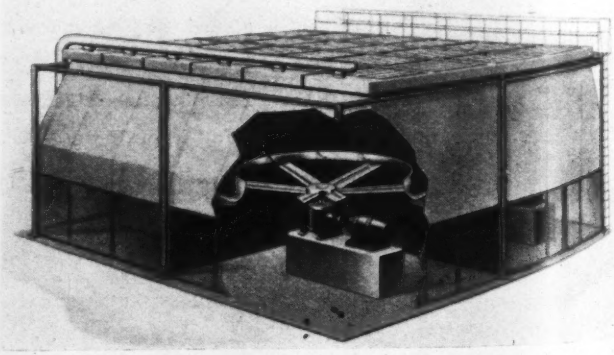


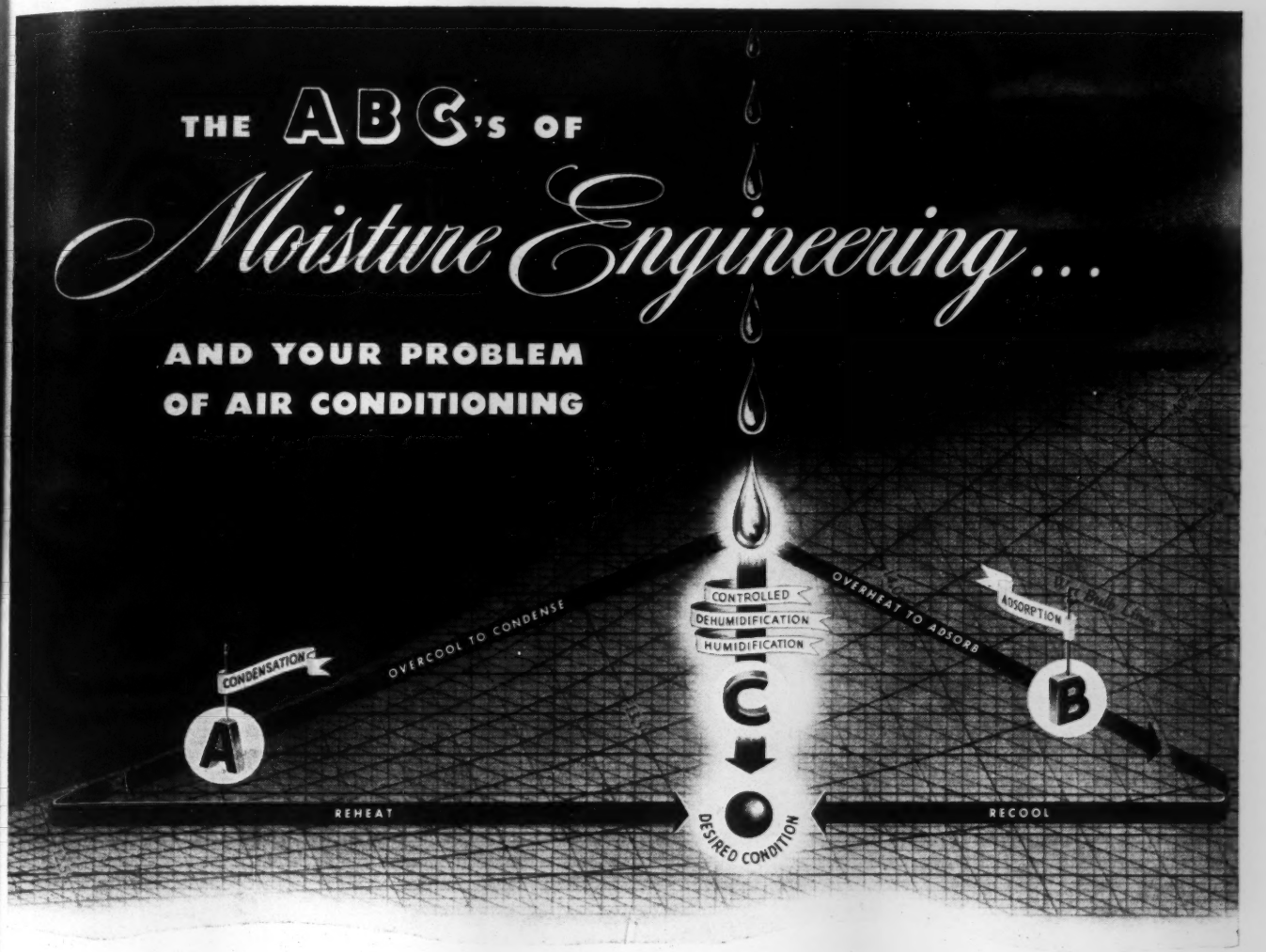
Normally this system is conventional in operation except that the hot gas from the compressor discharge enters the heat bank unit first, depositing some heat there before proceeding to the condenser.

Defrosting is accomplished in this way: At periodic intervals a timing device energizes a solenoid valve which opens and permits hot gas from the compressor discharge to enter the evaporator coil. The condensed refrigerant liquid on its way to the compressor enters the system's inner tank and is evaporated by the hot solution surrounding it and proceeds as a gas to the compressor. When defrosting is complete the timing device closes the solenoid valve, stops the flow of hot gas to the coil, and normal operation is resumed.

Fan Cooling Unit

No. 2841—Cooling sections employing "K-fin" tube construction are cooled by forced draft fed by air from the cooler layer at ground level and supplied by fans with variable pitch blades and with variable speed drive, in the unit illustrated. Vertical air flow against static head assures even air distribution over cooling surfaces. These "fin fan" units, which are manufactured by The Fluor Corp., Ltd., 2500 S. Atlantic Blvd., Los Angeles 22, Calif., are designed for pressures to 5000 psi and temperatures to 1500 F. Coils are located to provide sufficient static head for pump suction. Tubes can be removed and replaced quickly and all





Humidity can be the factor of success or failure in any plan for air conditioning. Unless it is properly controlled the result will be CHILL, SHOCK and CLAMMINESS in personal comfort atmospheres, or excessive cost of OVER-COOLING and REHEATING, or OVER-HEATING and RECOOLING to obtain the proper industrial processing atmosphere. Kathabar Systems operate independently of temperature and dehumidify or humidify to obtain the desired condition.

The above illustration is a common air conditioning problem. Three methods of approaching this problem are available.

Method A—(Condensation) Over-cooling the air to precipitate the moisture and then reheating to raise the temperature to the desired condition.

Method B—(Adsorption) Over-heating the air to arid dryness, then recooling to the desired condition.

In most instances it is difficult to maintain these conditions accurately.

Method C—(Kathabar System) Absorbing the moisture from the air, independently of temperature, and in accordance with predetermined control. Kathabar operation is thus the only direct, single function method in this instance. It will accurately maintain and automatically control the humidity to the desired amount for the specific purpose—either for personal comfort or industrial processing.

Get acquainted with a Moisture Engineer in your territory. Hear his story of "functional air conditioning"—see the new MOISTURE ENGINEERING and Kathabar Application Chart.

"The Moisture Engineer" is a new bi-monthly bulletin devoted to moisture-humidity problems in air conditioning and to Kathabar Systems and their application. Circulation will be limited. However, additional names can still be added to territory lists at the present time. If you would like to receive it, write to—

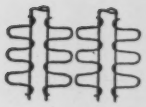
KATHABAR DIVISION, SURFACE COMBUSTION CORPORATION, TOLEDO 1, OHIO

AUTOMATICALLY CONTROLLING HUMIDITY FOR COMFORT AND INDUSTRIAL PROCESSING

Kathabar System of
HUMIDITY CONTROL
(ADVANCED AIR CONDITIONING)

Deep flanges extruded into headers give abundant tube brazing area.

Stream-lined copper tubes combine aerodynamic and heat transfer efficiency.



Individual copper fins have large-area bond to tubes Individual tubes "give" laterally to relieve expansion stresses between adjacent tubes.

Full floating element mountings relieve expansion stresses between core and cabinet.

Electrically welded cabinet provides rugged strength.

Low final temperatures for maximum comfort distribution.

Modern broad blade fans for quiet operation.

Rubber mounted motors contribute to vibrationless performance.

Made in a complete line from 100 to 1,000 EDR.

FEDDERS

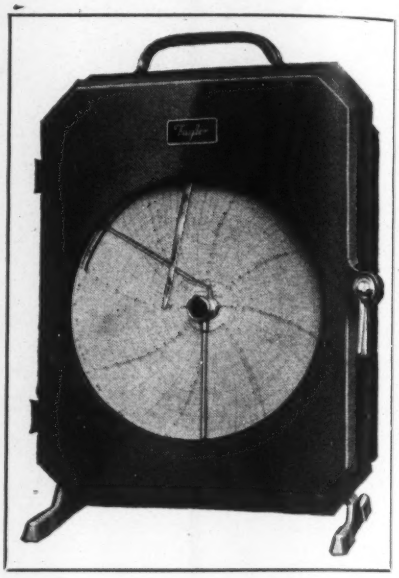
BUFFALO 7, N. Y.

mechanical equipment is readily accessible from the ground.

This unit—designed in cooperation with the Griscom-Russell Co.—is intended for use where water is scarce or expensive, where cooling water at lower than dry bulb temperature is not required, or where liquids, gases, or vapors under high pressure and high temperature must be condensed and cooled.

Portable Recording Thermometers

No. 2842—Suspended from the line for some time to permit mass production of more standard instruments for the war effort, the portable recording thermometer illustrated is now back on the market, says the Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y. This self-contained unit is a standard recorder except for the special temperature measuring system and the sturdy feet and carrying handle which have been added.



Originally designed for use in boiler rooms, enameling and japanning ovens, engine rooms, refrigerating rooms, brewery cellars, greenhouses, offices, etc., it has since found many useful applications in the chemical, food, and air conditioning fields.

These thermometers are available with numerous standard chart ranges within the following temperature limits: mercury-actuated instant, minus 38 to plus 200 F or equivalent C; vapor-actuated, 0 to plus 300 F or equivalent C. The instrument weighs 18 lb and measures 20¼ in. high, 13¾ in. wide, and 6¾ in. deep. Chart-driving mechanism can be supplied with periods of revolution to accommodate all regular recorder charts.

Rotary Pumping Unit

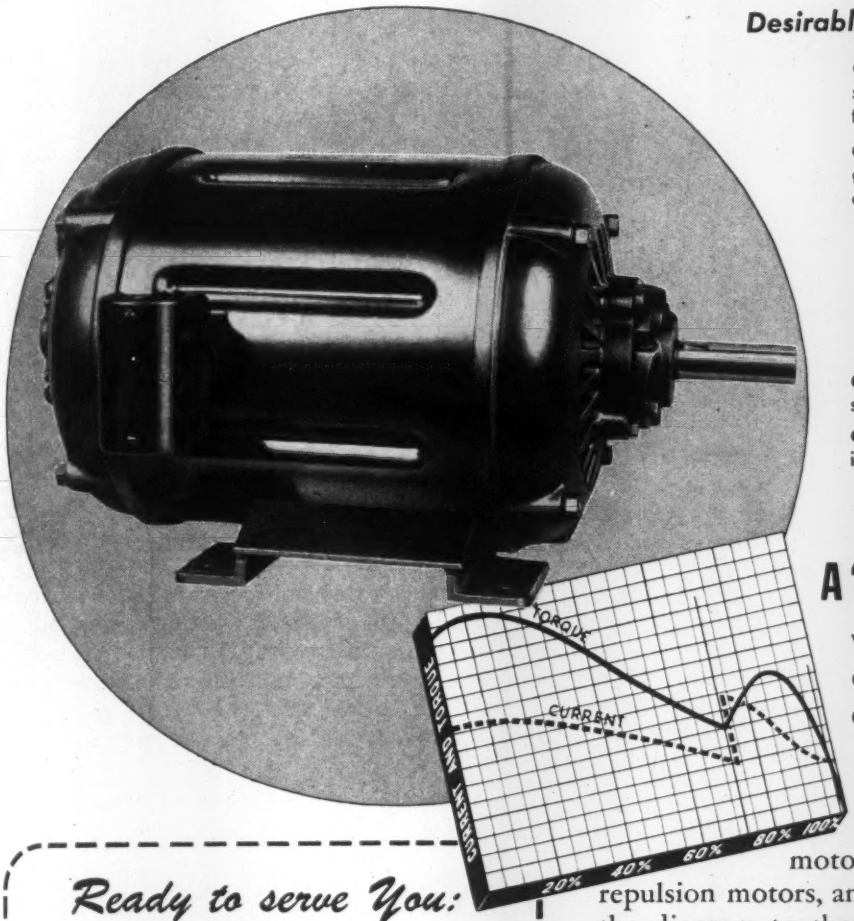
No. 2843—A steam jacketed rotary pumping unit designed for handling viscous liquids has been announced by the Blackmer Pump Co., 1920A Century Ave., S. W., Grand Rapids 9, Mich. The unit has a capacity of 500 gpm at 150 psi and is powered by a 75 hp gearhead motor with a speed of 155 rpm on the drive shaft. The pump construction is iron, bronze fitted. The entire unit is mounted on a cast iron base.

Units in capacities of 50, 90, and 200 gpm with gearhead motor or reduction gear drive are also available with steam jacketed heads. All of the new units operate on the "bucket" design, swinging vane principle.

Wagner REPULSION-START INDUCTION MOTORS ARE

A HAPPY COMBINATION

OF THE BEST FEATURES OF TWO TYPES OF MOTORS



Desirable Features of Repulsion Motors

- High starting-torque enables them to start high-inertia loads and accelerate them smoothly.
- Lowest starting-current of any type single-phase motor, therefore least likely to cause light flicker.

plus

Desirable Features of Induction Motor

- Fairly constant and high operating speed at all operating loads.
- Flat efficiency curve over wide operating range.

means

A "General-Purpose" Motor

which handles a wide variety of jobs efficiently and economically.

Wagner repulsion-start induction motors, as their name implies, start as repulsion motors, and operate as induction motors. As the diagram to the left indicates, the motors have a high starting-torque, yet have the lowest starting-current of any type single-phase motor.

At a predetermined speed, the motor is automatically changed to an induction motor by means of a mechanism which short-circuits the rotor winding and lifts the brushes from the commutator. Wagner repulsion-start induction motors are used on mechanical refrigerators, air compressors, pumps, coal stokers, various machine tools, large-size oil burners, coffee and meat grinders, and many other appliances. Wagner type RA motors are famous for their low upkeep cost, minimum servicing, freedom from vibration and noise, and years of reliable service.

M45-18

Ready to serve You:

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MOTORS are but one of several WAGNER PRODUCTS serving industry.
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AIR BRAKES
BRAKE LINING
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INDUSTRIAL BRAKES
INDUSTRIAL BRAKE CONTROLS
NoRoL
TACHOGRAPH (Recording Speedometer)
TRANSFORMERS

For Complete Information write for **Bulletin MU-185**

Wagner Electric Corporation

ESTABLISHED 1891
6370 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
In Canada: Wagner Electric at Leaside, Ontario
ELECTRICAL AND AUTOMOTIVE PRODUCTS

ADSCO
HEAT EXCHANGERS

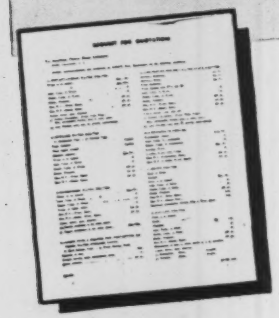
FOR HEATING . . .

Water for Washroom service ★ Water for process requirements ★ Water for space heating systems ★ Feed water ★ Water for swimming pools ★ Brine ★ Water for air conditioning ★ Fruit juices and other liquids ★ Molasses, oils, tars and other viscous liquids ★ Gasoline ★ Fuel Oil

FOR COOLING . . .

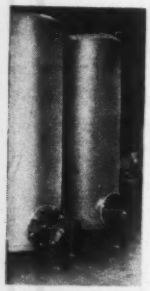
Condensate ★ Water for drinking water systems ★ Water for air conditioning ★ Quenching and cutting oils

FOR CONDENSING STEAM AND OTHER VAPORS



MAIL coupon for this SIMPLE FORM that makes it easy for you to get quotation.

The above is only a partial list of uses for which Adsco builds Heat Exchange equipment. If the exact purpose for which you require such equipment is not listed, chances are Adsco can build it. In some cases, your specific requirements can be met with Standard Adsco Equipment, in which case there would be certain advantages in cost and delivery. Often, however, it is necessary to design and build equipment to fill your space requirements and operating needs.
In either case you will benefit from Adsco's long experience in designing and building Heat Exchangers for a wide range of uses—experience that has given Adsco the engineering skill to analyze your problems—and recommend, or design and build the equipment to meet your exact requirements. Mail the coupon for the simple form illustrated above.



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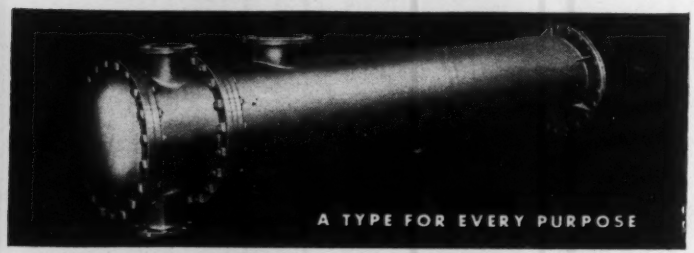
N. TONAWANDA, N. Y.
MAKERS OF "UP-TO-DATE" STEAM LINE EQUIPMENT
FOR OVER 65 YEARS.



American District Steam Company
North Tonawanda, New York

☐ Please send REQUEST FOR QUOTATION FORM

☐ Please send me Catalog EHP describing Adsco Heat Exchange Equipment.

NAME.....
TITLE.....
FIRM.....
ADDRESS.....
CITY.....
ZONE..... STATE.....

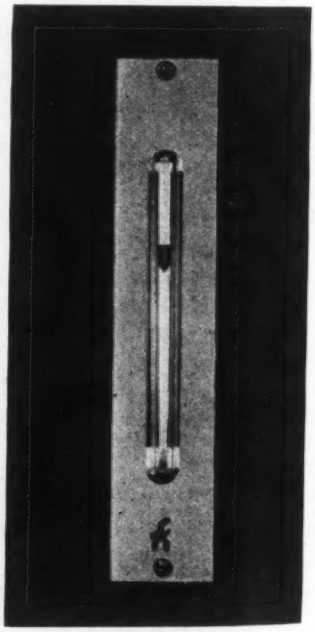
Pressure Gage Tester

No. 2844**—A new multipurpose pressure gage tester developed by Mansfield & Green, Cleveland, Ohio, combines in a single unit a pressure gage tester that can be used with equal facility for bench testing and for portable testing in the field, says the manufacturer. On bench testing, the unit can be used with test gages or with a dead weight attachment.

A check valve eliminates leakage and loss of pressure even with grit in the system, whether using oil or water and for pressures up to 10,000 psi. Principal uses of the testing unit include testing and repairing of pressure gages and instruments, the setting of relief or other pressure actuated valves and general hydrostatic testing.

Panel Mounted Flow Instruments

No. 2845—Designed to answer the need for panel centralization of instruments that indicate pressure, flow, temperature, etc., the new panel-mounted "Rotameter," manufactured by Schutte & Koerting, 12th and Thompson Sts., Philadelphia, Pa., offers several advantages, it is stated. The panel mount has a frosted glass window with a central clear glass aperture and is installed flush in the panelboard, with the instrument supported directly behind. Provision is made for adequate backlighting and ready maintenance accessibility.



* * * * *

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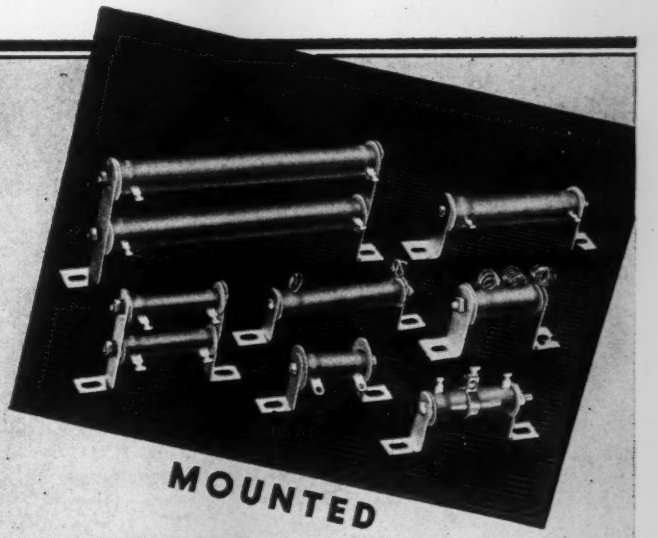
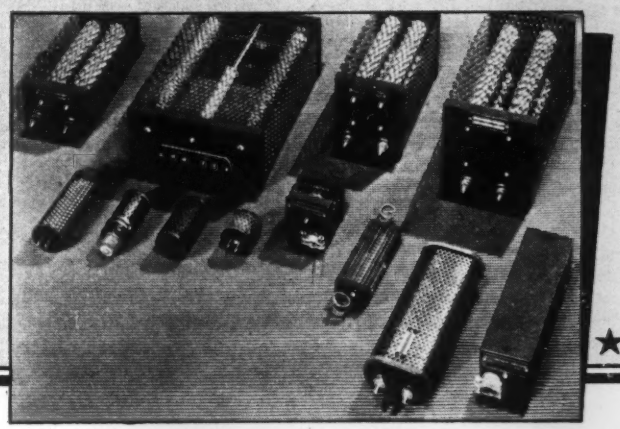


MOUNTED



ENCLOSED

THE LINE of Ward Leonard Wire Wound Resistors has been developed through over half a century of meeting the requirements of the electric and electronic industries. The line, therefore, is complete. Ward Leonard not only offers wire wound resistors of every type, size and watt rating, but also resistor asssemblies for usual and unusual purposes. You can find exactly the resistors you are looking for at Ward Leonard.

Send for the New Resistor Handbook. It describes the entire line giving full data on enclosures, mountings, terminals and resistance values.

ARMY E NAVY

WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control devices since 1892

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BUY MORE WAR BONDS

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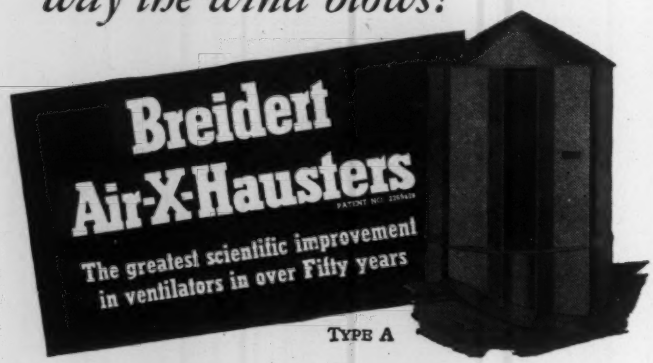
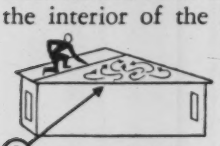
WARD LEONARD ELECTRIC COMPANY · 31 SOUTH ST. · MOUNT VERNON, N. Y.

Better ventilation without power costs...no matter which way the wind blows!



Because of the revolutionary, aerodynamically-correct design of the Breidert Air-X-Hauster, wind currents striking it from *any* angle are converted into a powerful suction force that rapidly exhausts stale air from the interior of the house, kitchen or building. The Breidert remains stationary, has no moving parts. *Back-drafts are eliminated where there is no interior negative pressure!*


1 In summer, attic temperature often reaches 30° to 40° higher than outdoors.

2 Breidert Air-X-Hauster exhausts hot, stale air at the high point of roof, and...

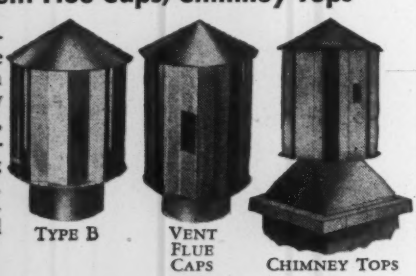
3 Fresh air enters at windows and doors, passes through register openings (R) and into attic, cooling entire house.

Unsurpassed for Kitchen Ventilation ... The Breidert system provides a continuous, silent, effective circulation of air that exhausts heat and odors *at their source*, with no operating or maintenance expense. There are no "hang-over" cooking odors because the exhaust action of the Breidert is continuous. The neat, compact appearance of the "Type A" Breidert (above) especially recommends it for residences.

Higher Capacities Certified by Smith, Emery ... Commercial laboratory* tests, made with wind blowing at *all* angles, prove the remarkably high capacities of the Breidert. Certified ratings are based on these unusual tests. **Smith, Emery & Co., Pacific Coast Branch Pittsburgh Testing Laboratories.*

Breidert Air-X-Hausters for Roofs, Vent Flue Caps, Chimney Tops

Breidert Air-X-Hausters provide safe, sure ventilation no matter which way the wind blows, eliminating backdraft and resulting annoyances. Thousands of installations have proved their superiority.



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REPRESENTATIVES LOCATED IN PRINCIPAL CITIES OF THE U. S.

ASTM Holds Short Annual Meeting

At the 48th annual meeting, held in New York on June 27 (this year because of war conditions a one session business meeting instead of the full five-day meetings customarily held) the American Society for Testing Materials authorized the adoption as formal standard of some 35 tentatives previously published and the adoption of some 40 revisions in existing standards. Since action on the formal standards, as distinct from tentatives, can be taken only at an annual meeting of the society, a business session was imperative and furthermore, culminating work over many months, changes are to be submitted to the members involving the by-laws, these changes providing for a larger board of directors, clarification of certain membership matters, and others. These changes are intended to have the society prepared for a most intensive peacetime continuing expansion of its work involving standardization of specifications and tests and the extensive research on properties of engineering materials.

The society's committee on standards, which has been functioning for many years, held a special meeting so that new tentatives and revisions of tentatives could be approved, thus eliminating consideration of these at the business session. This committee functions throughout the year, reviewing recommendations from the society's standing committees to determine that a consensus has been reached. Some 55 new tentatives were accepted which figure compares favorably with recent years, indicating that there is little diminution in the society's standardization work. Many existing tentatives were revised.

At an evening meeting sponsored by the New York district committee, the retiring president, P. H. Bates, gave his address on the Preparations for the Future of the ASTM, and Rear Admiral Lewis B. Combs, Assistant Chief, Bureau of Yards and Docks, as guest speaker spoke on Preparing the Way for Victory with the Seabees. This was followed by the first formal showing of the Navy film on the erection and use of the floating drydocks which have contributed so much, particularly in the Pacific, to the maintenance of the fighting fleet.

While actions on the adoption of formal standards were reasonably scattered throughout the society's committee work in the field of metals, construction materials, and the general nonmetallic materials, certain committees had a number of such actions approved. Committee B-5 on copper and copper alloys, cast and wrought, for example, had two of its important tests, one the expansion test for copper tubing, the other the mercurous nitrate test, and specifications for brass wire, alloy condenser tube plates, forging rods, bars and shapes, and the classification of cast alloys; all are to be referred to society letter ballot for final action.

In the field of light metals, three previous tentatives will be eventually adopted covering anodically coated aluminum, test for sealing, for weight of coating, and dielectric strength.

Other items to be balloted on cover the field of soaps and other detergents, chemical analysis of metals, refractories, and thermal insulating materials.

The new officers of the Society, whose terms became

Which will it be in a highly competitive tomorrow?

EFFICIENT business never has money to burn — a fact that will prove doubly important tomorrow when every expenditure will count heavily in a keenly competitive market.

Yet, while your boiler plant equipment remains outmoded, you may be tossing $10 (or more) out of every $100 paid out for the production of steam, right into the fire. You're simply not securing *full* use of your oil or gas.

That's where Todd Automatic Burners for liquid or gaseous combustion mean the *profitable* difference between high and low-cost steam.

Regardless of the type specified, Todd oil or gas burners actually shave steam production costs up to 10% or better. At the same time, they step up power capacity to maximum and cut maintenance charges to the bone.

For *cheaper* production of power and heat, for industrial or commercial use, you're *combustion-wise* when you *modernize* with *Todd.* Our engineers are at your ready disposal for consultation on your specifications.

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COMBUSTION EQUIPMENT DIVISION
TODD SHIPYARDS CORPORATION
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NEW YORK, BROOKLYN, ROCHESTER, HOBOKEN, NEWARK, BARBER, N. J., PHILADELPHIA, SO. PORTLAND, ME., BOSTON, SPRINGFIELD, MASS., BALTIMORE, WASHINGTON, CHICAGO, GRAND RAPIDS, TAMPA, GALVESTON, HOUSTON, MOBILE, NEW ORLEANS, LOS ANGELES, SAN FRANCISCO, SEATTLE, TACOMA, MONTREAL, TORONTO, BUENOS AIRES, LONDON

ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

effective at the close of the annual meeting, include as president, J. R. Townsend, materials engineer, Bell Telephone Laboratories, Inc.; vice-president, T. A. Boyd, head, fuel department, research laboratories division, General Motors Corp.; and the following five members of the executive committee: John R. Freeman, Jr., L. J. Markwardt, Carlton H. Rose, L. P. Spalding, and William A. Zinzow.

Condensing Unit Manufacturers Meet

Representatives of the nine member companies of the Refrigeration Condensing Unit Manufacturing Association, which composes the product section of the Refrigeration Equipment Manufacturing Association, completed the organizational structure of this new group and established committee personnel at their meeting in Cleveland on June 26.

Of extreme interest to the representatives in attendance were the remarks of W. Y. Rahan, vice-president of the Commercial Credit Corp., who expressed the belief that owners of war bonds would hold them for maturity, and that most purchases would be made on installments out of income.

Mr. Rahan outlined a plan for installment selling of commercial refrigeration equipment which has had wide acceptance. This plan calls for a minimum down payment of 25 per cent of the contract exclusive of trade-ins and a maximum of 18 monthly payments.

A proposal that repair parts be packaged and properly labelled for protection and quick identification on jobbers' and distributors' shelves met with considerable favor. Plans for the production of packaged repair kits were also disclosed by several members.

The members also discussed uniform installation and service instructions, jobbers' relations and catalogs, export problems, labor relations and the new OPA plan for the consideration of requests for price increases by manufacturers.

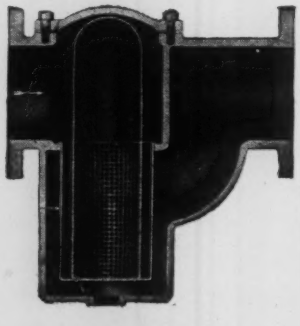
The association plans another meeting in the fall.

Water Heater Order Amended

Water heaters subject to provisions of the order controlling the distribution of plumbing, heating and cooking facilities (L-79) have been redefined to exclude types formerly covered by order L-123, which was recently revoked, the War Production Board said July 9.

Order L-79 as amended changes the definition of water heaters, which appear on list A. The delivery to consumers of items on list A is permitted only for replacement of wornout, damaged, or destroyed equipment and on rated orders. Water heaters as now defined are direct fired and indirect types. However, the definition excludes indirect water heaters having a coil or a nest of tubes installed in a shell or pressure vessel with a diameter larger than 12 in. (or if other than circular in cross section, having an internal cross sectional area larger than 113 sq. in.); it also excludes industrial and direct handfired solid fuel hot water heaters of the following types: bucket-a-day stoves, dome type water heaters, and service water tank heaters.

TO ELIMINATE SHUT-DOWNS..One of the reasons so many plants STANDARDIZE ON K & M STRAINERS



Type 330. Basket or Suction Strainers. Type 340. "Y" Strainers.

A big family to give positive protection to pipe lines and equipment in steam, gas, water, oil and chemical applications . . . "Y" basket and straight-flow strainers from 1/2" to 18". Every size and every type for high and low pressures — designed with over-size open basket areas to deliver minimum pressure drop, regardless of pressure conditions. Baskets are easily removed, with plug or blow-down connection for cleaning. Bodies are standard or extra heavy semi-steel, bronze, galvanized, or series 15, 30, 40 or 60 cast steel. Strainers are bronze, stainless steel, monel, wire cloth or special alloys, with perforations of 1/64, 1/32" or larger. Prices are reasonable. Write for Catalog 66-C.

KIELEY & MUELLER, INC.
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS SINCE 1879
2015—43RD ST., NORTH BERGEN, N. J.

66 YEARS OF CONTROL PROGRESS

If it's to be painted insist on this *TRIPLE PROTECTION*

See Sweet's Catalog for uses, advantages and general specifications of these Armco special-purpose sheets:

Galvanized ARMCO Ingot Iron.

ARMCO Galvanized PAINTGRIP Steel (also available with ARMCO Ingot Iron or Copper-Steel base)

ARMCO Stainless Steels

The "Scratch Test" shows how paint sticks to ARMCO Galvanized PAINTGRIP. The top half of the sample is Bonderized at the mill. When scratched with a penknife only a slight mark can be seen. Paint on ordinary galvanized steel (bottom half) scrapes off readily.

This "peel-off" drawing clearly shows the advantages of ARMCO Galvanized PAINTGRIP Steel for *all sheet metal work to be painted.*

No. 1 is the smooth, tight paint finish that can be applied as soon as the work is done, and lasts several times longer than paint on ordinary galvanized or uncoated sheets.

No. 2 is the special mill-Bonderizing that takes and preserves the paint without pre-treatment. No fuss, no bother, no added cost.

No. 3 is the full-weight galvanized coating that protects the high-quality iron or steel base from rusting.

Remember, it actually costs less to use ARMCO Galvanized PAINTGRIP than ordinary galvanized and acid-etch it before painting. You get a smooth job in less time and it stays attractive longer. Exposed air ducts, furnace casings and other painted work—these are just a few of the heating and air conditioning uses.

Write for the ARMCO PAINTGRIP booklet, which gives complete information on fabricating, finishing and applications of this special sheet steel. The American Rolling Mill Co., 1721 Curtis St., Middletown, Ohio.

THE AMERICAN ROLLING MILL COMPANY

Special-Purpose Sheet Steels

STANDARDIZE MARKINGS FOR HAZARDOUS MATERIALS

A comprehensive effort to systematize and standardize labeling of hazardous chemicals, a project considered to be of special importance to the nation in view of the pace of developments in the industry during modern times, has been completed after a year's work by the Manufacturing Chemists' Association of the United States, 608 Woodward Bldg., Washington 5, D. C., and the results are being published in a manual entitled A Guide for the Preparation of Warning Labels for Hazardous Chemicals.

A principal objective of the work is to discourage depending upon code labels which leave the user with no information about the product. The manual outlines the principles that should govern preparation of precautionary labels, with maximum emphasis on protecting the users, handlers, repackers, jobbers, and distributors of chemical products or others who may be less familiar with them than the manufacturers.

The classification of hazards adopted is as follows:

1) Flammable liquids and oxidizing agents which support combustion. (A. Flash point 20 F or below. B. Flash point above 20 to 80 F inclusive. C. Flash point above 80 F.)

2) Flammable solids and oxidizing agents as classified by the ICC.

3) Vapors immediately toxic or extremely irritating even on exposure for a short time or to low concentrations.

4) Vapors hazardous from prolonged or repeated exposures, or exposure to higher concentrations.

5) Vapors physiologically inert.

6) Harmful dusts.

7) Skin irritants—corrosive.

8) Materials causing skin irritations after repeated or continued contact.

9) Materials toxic through vapor inhalations or skin absorption.

10) Toxic if taken internally. Applies to materials covered by statutory definition of poison liable to be destructive of human adults in doses of 60 grains or less or to any material toxic in amounts likely to be taken internally through easily anticipated errors.

GAS HEATING NOW PERMITTED

Revocation by the War Production Board of its limitation order L-174 permits deliveries of manufactured gas to new installations of residential space heating equipment and new industrial loads on manufactured gas systems. Thus, the availability of the necessary equipment, particularly—it is understood—controls, is the only restriction on the use of manufactured gas for space heating.

Among other WPB orders recently withdrawn or revised is L-299, covering pressure parts of power boilers; the revocation eliminates specifications of pressure parts of all power boilers, except locomotive or marine.

Schedules I, II, and V, covering water meters, steam surface condensers, and high voltage insulators, respectively, have been eliminated from L-154. Orders U-1, U-3, and U-4 have been amended to permit all construction by utilities without previous authorization from WPB, except for building materials cost in excess of $25,000.

"Killer" CALL BACK

When you use a faulty tee, ell or flange you are extending a special invitation to "KILLER" Call Back, the waster of your time . . . the despoiler of your profits.

In fittings, no other grade but the best yields a profit. "K's" are high grade, thoroughly inspected fittings and when properly installed there are extremely few call backs.

The "K" line is complete . . . every type and size you will require.

COMPLETE LINE. CATALOG ON REQUEST.

Standard and extra heavy cast iron screwed fittings.
Standard flanged fittings.
Standard and extra heavy companion flanges.
Drainage fittings.

"K" fittings carried in stock at Malleable Iron Fittings Company, Branford, Conn.; M. I. F. stocks at Kuhns Brothers Co., Dayton, Ohio.

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Soliciting
POST-WAR BUSINESS
Send Specifications Now..Insure Quick Shipment when Priorities are Lifted

FACTS OF L-H FORCED DRAFT COOLING TOWERS

Fans blow air in at base of tower through fan openings; out top through eliminators. Airflow is counter-current to falling spray water.

Walls are made of two thicknesses of 1 x 6 tongued and grooved sheathing, made in panels; liberal air space between water-tight interior and exterior sheathing.

Driving units at base of tower permit quick inspection and adjustment of fan assembly.

Spray Distribution

Water is uniformly distributed by trough distributing system or spray nozzles.

L-H removable filling gives uniform distribution of water and air.

General Data

Teco split ring timber connectors develop 100% working stress of members. Towers constructed of Heart Redwood, or Tidewater Red Cypress. Equipped with spray eliminator system at top, zigzag pattern of three tiers. Drift loss amounts to less than .2 of 1%.

Write for: Catalog 440-A

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COOLING TOWERS, INC.
Manufacturers of All Types of Water Cooling Towers
GENERAL OFFICE: 4239 DUNCAN AVE., ST. LOUIS 10, MO.
PLANTS AT ST. LOUIS, MO., AND PLAINVIEW, TEXAS

IT COSTS SURPRISINGLY LITTLE TO STOP VIBRATION with KORFUND

VIBRATION CONTROL

Isolation of noise and vibration is as essential to personal comfort as correct air conditioning and ventilation. Yet the cost of Korfund Vibration Control is only a small percentage of the total installation.

Korfund engineers, with over a quarter of a million successful installations, offer the most economical solution for each vibration problem. Employing Cork, Rubber, and Steel Springs in a wide variety of designs, Korfund is able to make an unbiased selection of the isolating material.

Use Korfund Vibration Control for positive results . . . at minimum cost.

Write for descriptive literature or for a quotation.

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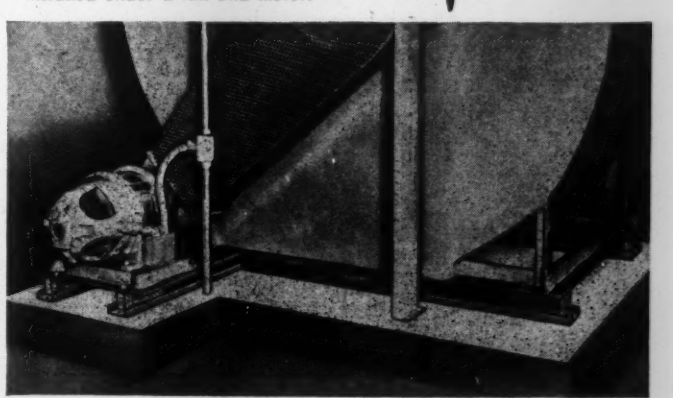
KORFUND
VIBRATION CONTROL

Korfund Vibro-Bar Integral Base installed under a fan and motor.



More Service... Less Upkeep

UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
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RIGID

Heavy-Duty Pipe Wrench

● It looks different—but the real difference is in its performance. The housing simply won't break or warp—no bother or expense of repairs. Full-floating hookjaw (with handy pipe scale) and replaceable heeljaw take hold instantly, won't lock on pipe. Adjusting nut in open housing spins to pipe size. Powerful comfort-grip I-beam handle eases hard pulls. Ask your Supply House for the rugged work-saver RIGID. We're manufacturing more of them than ever, but it's not enough—please be patient.

Strap Wrench, pipe to 5".

RIGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

• NEW BOOKS & REPORTS •

Comfortization of Aircraft

Comfortization of Aircraft, by Albert A. Arnhym, the first book in its field, is a complete and thorough treatment of the design of comfort-producing equipment for aircraft. The factors influencing comfort in a plane, the many special features embodied in equipment for heating and ventilating planes, and the many special design methods and data are all discussed in this excellent book in detail. The many clear illustrations and charts contribute much to the treatment.

The first six chapters deal mainly with background material—topics such as requirements for passenger comfort, comfort in relation to plane size and classification, comfort standards, and equipment planning.

Chapters 7 to 11, inclusive, are concerned mainly with air handling problems. Requirements of air supply, methods of air supply and distribution, and duct design are all treated from the special viewpoint of the airplane.

The next group of chapters, from 12 to 17, deals with the problem of heating airplanes. The methods of computing the heat losses from planes, the various methods of air supply and distribution, and duct de- of the heat supply are all covered. Internal combustion heaters and exhaust gas heat exchangers are discussed in a fashion that is likely to be of considerable interest to those concerned with the application of lightweight surface to building heating equipment.

Two chapters on soundproofing, a chapter on lighting, and three remaining chapters on various phases of comfort complete this book.

To engineers familiar only with the heating and ventilating of buildings, this book will provide an unusual and worthwhile slant. Although the comfortization of planes is a relatively new field, this book is concrete evidence of the fact that it has advanced far.

There are 347 + xii pages, 6x9 in. The publisher is the Pitman Publishing Corp., 2 W. 45th St., New York 19, N. Y. The price is $7.50.—W. G.

Going Into Business

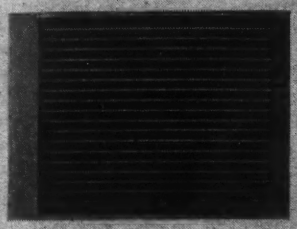
The New York Public Library devoted a double issue of its branch library book news (May-June) to Going Into Business, a bibliography of practical aids to the small businessman (books, pamphlets, trade journals, bibliographic aids).

According to Leo Cherne, executive director and editor-in-chief of the Research Institute of America, figures based on an army survey indicate that one out of every seven men in the army is looking forward to the day when he can establish his own business.

The booklet contains a list of 50 basic books covering all phases of business management, annotated when necessary. Under the heading On Your Own, books on the special problems of small business are included as well as a classified list of references on 22 major retail trades and service establishments in the New York City region. A classified list of 30 trade journals in the field of small business supplements book and pamphlet in-

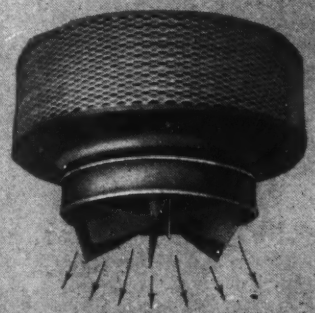
McCORD
HEATING AND AIR CONDITIONING PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES



All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS



A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS

A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p.s.i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.

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REG. U.S. PAT. OFF

OIL BURNING SYSTEMS

Petro Class A (Industrial) Equipment is currently available under W.P.B. regulations and ratings.

Petro equipment includes:

DOMESTIC "CONVERSION" BURNERS
1 to 6 gal. per hour

LARGER "LIGHT (No. 3) OIL" BURNERS
general application type
6 to 18 gal. oil per hour

COMBINATION BURNER-GENERATOR UNITS
both steel and C. I. sectional boilers; forced warm air units; and instantaneous water heaters.

INDUSTRIAL OIL BURNERS
Manual - Semi Auto - and Automatic* for either un-heated or pre-heated industrial oils, up to 145 g.p.h. Built-in motor or belt drive.

**When pre-heated oils are burned the Petro Thermal Viscosity system insures consistent maximum combustion efficiency at all firing stages, automatically and reliably.*

Petro Engineering co-operation is still available. Research-development is active. When your post-war activities start, Petro will be ready for you.

OIL IS AMMUNITION USE IT WISELY

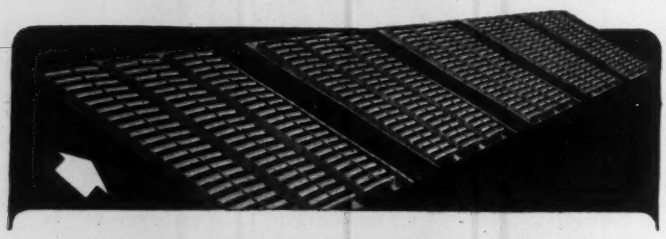
Full data on Petro Industrial Burners are in our Catalog—see Sweet's or Domestic Engineering Catalog Files — or we will gladly send copies on request.

PETROLEUM HEAT AND POWER COMPANY

Makers of Good Oil Burning Equipment Since 1903

STAMFORD CONNECTICUT

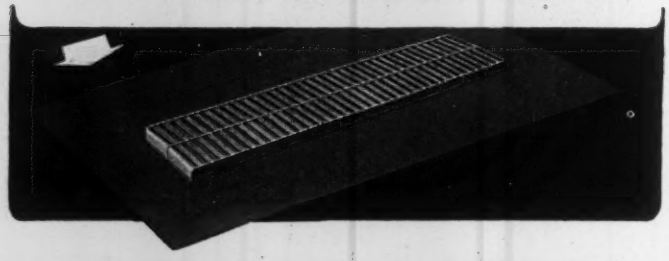
Whether the Buildings you plan to ventilate call for



a whale of a lot of ventilation

or

selective heat and smoke removal



specify Swartwout *AIRMOVER*

The "open roof" method of industrial ventilation

This modern improvement in industrial ventilation is most flexible, providing complete large scale air movement where you need it, or serving restricted "hot spot" areas as desired. Uses no power; can be regulated to exhaust any portion or full exhaust as required.

AIRMOVER exhausts large quantities of heat, smoke and fumes *rapidly* through its short-air-travel, low-air-friction construction. It's only 32" high, built in rectangular units that can be placed on any type roof. Standard units are 10' wide but can be made any width to meet special requirements. No special structural support needed—therefore low installation cost. Industrial buildings all over the country have been equipped with outstanding success. Write for information.

THE SWARTWOUT CO., 18511 EUCLID, CLEVELAND 12, OHIO

Swartwout

Specialists in Air Movement by *Natural* Methods

"There's a little bit of a thrill to watching a carload of WHEATLAND steel pipe roll out. That carload might be shipping to just about any place on the map. My job is in the shipping department, a first-hand spot to see how ably WHEATLAND is equipped for that purpose.

"WHEATLAND steel pipe is working for the world, so an ideal location was chosen to enable us to service through the major railroad systems of the nation. Times like these require hurried schedules, and a good job rests not only on a superior product but on speedy delivery to the customer as well.

"We fully understand the problems of the jobber and realize how much he depends on prompt shipments. The wheel of cooperation among WHEATLAND employees moves out into the field of our customers, for we've discovered that in helping toward each other's needs, we can all benefit."

Plant: Wheatland, Mercer County, Pa.
General Offices: Real Estate Trust Building
Philadelphia 7, Pa.

WHEATLAND TUBE COMPANY

formation. Publisher, date, and price are included.

The list is available for 10c from the Public Relations Department, New York Public Library, 476 Fifth Ave., New York 18, New York, or free upon application at any branch library.

Battelle Memorial Institute Research

A 72 page catalog of the publications and patents which have resulted from 15 years of fundamental and applied research has just been published by the Battelle Memorial Institute.

Founded to advance education, science, and industry through research and through the dissemination of technological information, Battelle has published widely in the nation's technical and scientific journals. The new catalog lists more than 800 such journal contributions, books, and patents between the years 1929-1944, inclusive.

The catalog includes subjects in the fields of organic chemistry, electrochemistry, chemical engineering, graphic arts, welding technology, applied mechanics, mineral dressing, industrial physics, ceramics, fuels, and metallurgy.

Copies of the catalog are available on written request on university or company letterhead to the Battelle Memorial Institute, Columbus 1, Ohio.

Viscosity of Gases at High Pressures

The Viscosity of Gases at High Pressures, by Edward W. Comings, Bertrand J. Mayland, and Richard S. Egly, is the outcome of a graduate thesis at the University of Illinois. The results presented should be of considerable utility in the design of high pressure gas piping for any purpose. The data and charts, from the care evidently taken in obtaining and correlating them, should be quite accurate.

Page 45 has a chart which correlates the viscosity ratio (defined as the ratio of the viscosity at any selected temperature and pressure to the viscosity at atmospheric conditions—where pressure variations have a negligible effect) to the reduced temperature and pressure. Reduced pressure or temperature is the ratio of the temperature or pressure at the selected conditions to that at the critical point, which data are easily obtainable.

This chart is said to be applicable for any gas at high pressure, and it is of interest that the viscosity at very high pressures may be as much as 10 times the viscosity at atmospheric conditions, where most such measurements are made. The importance of this when designing for high pressure fluid flow or heat transfer equipment, the equations of which contain viscosity as one of the variables, is obvious. For example, the thermal conductivity of carbon dioxide at 50 atmospheres pressure and 10 C is 6.4 times its value at atmospheric pressure while the viscosity ratio is 6.347. This, the authors state, is because the thermal conductivity depends upon the transfer of one kind of molecules through other molecules, which property is measured by the viscosity. Anyone designing high pressure equipment will find this work of exceptional value.

Identified as Bulletin No. 354, copies may be obtained on application to the Engineering Experiment Station, Urbana, Ill.—R. K. DEUTSCH.

For STOKERS

The CROWN Unbreakable Coal Feed Screw

NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★ Crown's complete line of all-steel Coal Feed Screws meets every replacement and production requirement. Produced for both domestic and industrial stokers. Crown Screws are available with right or left hand screws, in all sizes and pitches, tapered or straight, and in combinations of pitches. Uniformly smooth surfaces insure that coal will flow freely and easily through the flights. Because it is all-steel with continuous weld, the Crown Coal Feed Screw guarantees long, continuous operation with full customer satisfaction. Crown is in a position to make prompt delivery on all sizes.

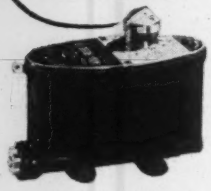
In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY

1202 Tyler St., N. E. Since 1878 Minneapolis, Minn.

Safely Uniform Warmth and Comfort

THIS CONSTANT LEVEL OIL CONTROL



is standard equipment on most good oil-burning heaters now . . .

Just add the A-P ELECTRIC AUTO HEAT CONVERSION TOP to the A-P Control now on your heater.

Then install this A-P Thermostat on the wall, and you will have COMPLETLY AUTOMATIC HEAT CONTROL—always uniform and dependable.

● For Homes where the Space Heater is Equipped with (AP) Thermostatic Temperature Control . . .

WIN the gratitude of your oil-burning Space Heater customers by helping them to stretch their fuel allotment—prevent fuel waste—and still enjoy uniformly warm homes in early spring. The A-P Thermostatic Temperature Control for Oil-Burning Space Heaters using A-P Model 240 DR or UR Manual Controls is the equipment that will insure this comfort and fuel-saving economy.

TEMPERATURE CONTROL like this soon returns much more than its original cost—in fuel savings and uniform heating comfort. Feature it NOW for sales and profit!

AUTOMATIC PRODUCTS COMPANY

2460 North 32nd Street Milwaukee 10, Wisconsin

(AP) **DEPENDABLE** *Oil Controls*

Refrigeration and Air Conditioning Engineering

Most of the books in the air conditioning field seem to take one of two approaches to the subject. One type begins with the conventional heating systems and leads up to the more complete ventilating and air conditioning systems, with refrigeration playing a more or less minor part. The other type begins with the fundamentals of refrigeration and then discusses air conditioning as an application of this field of engineering, with conventional heating systems playing only a very minor part. Refrigeration and Air Conditioning Engineering, by B. F. Raber and F. W. Hutchinson, is of this latter type.

The primary purpose of this new book is to present a comprehensive treatment of the fundamental theory underlying refrigeration, heat transfer, and air conditioning. The authors—professor and associate professor, respectively, of mechanical engineering at the University of California—have produced a treatise of outstanding and lasting value, and have succeeded in stating in a clear and concise manner the scientific and mathematical principles governing this field of engineering.

The chapter sequences are arranged in logical order, starting with basic thermodynamic principles and continuing with the vapor refrigeration cycles. The simple and the most complex vapor compression refrigeration cycles are discussed at considerable length with very detailed analyses of the theoretical and actual cycles which might be found in any refrigeration application. The steam jet system, the reverse refrigeration or heat

Before you buy, ask these questions:

1—Is the Underground Pipe Conduit Properly Supported?

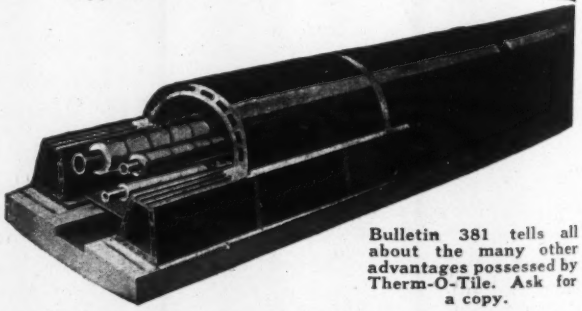
2—Will it sag and permit the formation of condensate pockets?

THERM-O-TILE

Reg. U. S. Pat. Off.

Underground Pipe Conduit

cannot sag. The "Spread Footing" Foundation (see photo below) holds the original grade PERMANENTLY. Yes, Therm-O-Tile IS Properly Supported.



Bulletin 381 tells all about the many other advantages possessed by Therm-O-Tile. Ask for a copy.

Sold and installed by Johns-Manville Construction Units in all Principal Cities. See Sweet's Architectural File, or, The Heating Guide.

H .W. PORTER & CO., Inc.

822-H Frelinghuysen Ave. Newark 5, New Jersey

Permanent, Postwar

SALESMEN'S OPPORTUNITY

OPEN NOW

Four or five men with heating or combustion backgrounds are wanted at once by an equipment manufacturer for trade-contact marketing work in established territories. Selling ability and experience are essential. Knowledge of, and liking for, mechanics or engineering will be very helpful in this work.

The type of man most likely to be successful in this particular work could be a technical school graduate who has had a couple of years or more experience in selling heating equipment, power plant specialties, combustion control equipment, stokers or oil burners to wholesale distributors and, or, installing contractors. However, a college degree is not a first essential. A practical working knowledge and some experience in heating and power plant work coupled with sales ability is what the job requires.

The Company that wants these men is old and well established in this field. It is respected, progressive, well financed, and is currently planning further expansion and progress in its products and markets. These plans definitely include aggressive promotion and marketing to re-inforce the personal efforts of its representatives.

The line is already well known to the trade and the public and has an enviable performance record and users' satisfaction of many years standing. This line is now in process of further refinement and expansion. Its market is international and growing.

All the men now in this company's marketing division have read this advertisement and agree it is a fair and conservative outline of an opportunity. It is a competitive field, and the work will be varied and interesting, but not attractive to anyone looking for a "pushover".

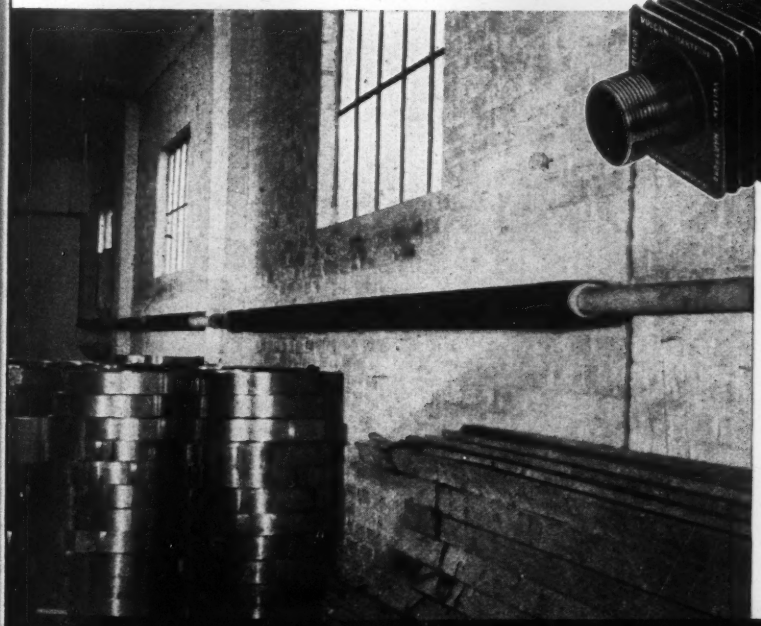
Every response to this advertisement will receive executive consideration. No inquiries will be made until after an interview has provided a basis for such inquiry and the applicant has authorized it. Interviews can be arranged at practically any time and place, and will be requested on the basis of personal and business experience data in the responses received. It is requested that such data be complete and specific enough to provide an informative outline.

Box 469-A

Heating, Piping & Air Conditioning

6 North Michigan Avenue
Chicago 2, Illinois

VULCAN *compact radiation* *for* BETTER HEATING



"VULCAN—HARTFORD"
stamped on every radiator

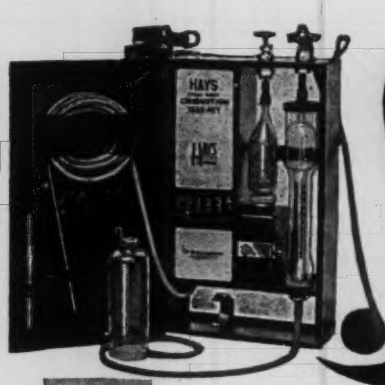
Continuous line radiation . . . permanently fastened fins on seamless steel pipe . . . is Vulcan's contribution to Controlled Temperatures. Although unit sections are extremely compact, heating surfaces are tremendously expanded so that air currents are drawn to them, heated and gently circulated throughout the entire room area. This is convection heat at its best . . . uniform,draftless.

Installation is fast and simple as few fittings are needed and all parts are light in weight. Maintenance is no problem, long life is assured. Specify VULCAN.

ASK FOR BULLETIN

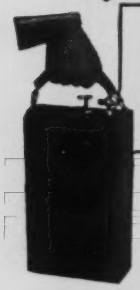
Representatives in Principal Cities

THE VULCAN RADIATOR CO. 26 FRANCIS AVENUE, HARTFORD 6, CONN.
RADIATOR MANUFACTURERS FOR ALMOST TWO DECADES



Engineers EFFICIENCY ANALYSIS SERIES 3000 TEST SET

HAYS COMBUSTION SET



Portable
SIZE OF CASE 7⅛"x5"x15" HIGH
WEIGHT 9 LBS.

For accurate, quick combustion analysis. Combines single unit gas analyzer with a diaphragm type draft gage and flue gas thermometer. Completely enclosed in steel case with leather handle, weight 9 lbs. Of particular benefit to service and heating engineers and installers of oil and gas burners, stokers, furances, and boilers. Full details in Bulletin 43-362.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

EASY TO READ DIAL THERMOMETER

Economize WITH POWERS TEMPERATURE REGULATORS

POWERS

Use a Powers No. 11 Temperature Indicating Regulator when you want the advantages of an easy-to-read dial thermometer combined with a dependable self-operating regulator. The dial thermometer gives a visual check on the performance of the regulator and makes it easy to adjust for the required operating temperature. Various dials and ranges are available.

Is Easy To Install—because both the thermometer and the regulator operate from the same thermal system—only 1 tapped opening is required. Write for Circular 2511.

THE POWERS REGULATOR CO.
2759 Greenview Avenue, Chicago 14, Illinois
231 E. 46th St., New York 17, N. Y.—Offices in 47 cities. . . . See your phone directory.

CONTROLS HEATING OR COOLING MEDIUMS

POWERS

OVER 50 YEARS OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL

Spraying Systems nozzle, type "Whirljet."

Is there a THIEF in your air conditioning system?

Spray Nozzles are always an important factor in obtaining efficiency in an air conditioning and cooling system. Spraying Systems nozzles, hydraulically engineered and precision built, can provide atomization and distribution exactly as required for any given water volume and pressure. Spray Nozzles are available for every air treatment problem in a range of sizes to meet any specification. Write for Catalog No. 22 . . . a 30-page Spray Nozzle reference manual.

SPRAYING SYSTEMS COMPANY
4033 West Lake Street • Chicago 24, Illinois

SPECIALISTS IN THE DESIGN AND MANUFACTURE OF SPRAY NOZZLES

pump cycle, and the absorption cycle are all discussed. The illustrations of the latter cycle are limited to the ammonia-water system. A knowledge of elementary thermodynamics and mathematics through the calculus is necessary for proper understanding of the material presented.

The subject of heat transfer is more completely discussed than is usual in a book of this type. This discussion starts with steady state heat transfer, and includes conduction, convection, and radiation. The discussion continues with the general differential equation of conduction as applied to periodic heat transfer through walls and air spaces and to the analysis of transient heat flow.

It is pointed out that these discussions of periodic and transient heat transfer frequently make it possible to compute more closely the capacity of the refrigeration system as compared with assuming the maximum load required by assuming only steady heat flow. In other words, the variable heat flow problem is the one actually met with in air conditioning applications. Hence, it is proper to present the basic theory which permits the calculation of these variable (with respect to time) amounts of heat.

The psychrometric properties of air and the construction of psychrometric charts is clearly discussed. The difference between the sigma heat function of Carrier, the true enthalpy of air-water vapor mixtures, and the constant wet bulb temperature process are all clearly explained.

The psychrometric chart is then used in discussing the five critical loading conditions which an air conditioning system has to meet, and an area is sketched on

the chart which shows the limits of the condition of the supply air to a conditioned space with various amounts of air volume and with various ratios of sensible to total heat gains in the space. The next several chapters of this part of the book discuss the equivalent bypass concept of the contact mixture analogy of Carrier as applied to heating and cooling coils, surface cooling, and direct contact equipment such as air washers.

The latter part of the book is given to a discussion of the heat requirements of air conditioning for human comfort and for health, together with the selection of fans and ducts required to convey the air to the conditioned space. This latter discussion is very brief and hardly complete enough to teach the design of air distribution.

No review of this work would be complete without mentioning the great stress which has been placed upon the use of grapnical solutions of problems throughout the book. Trace sheets have been designed to be used in conjunction with the conventional pressure-enthalpy chart of the refrigerants to give graphical solutions to problems involving the amount of refrigerant circulated and the horsepower required to drive the compressor. The graphical solution of the problems of periodic and transient flows is a valuable part of these discussions.

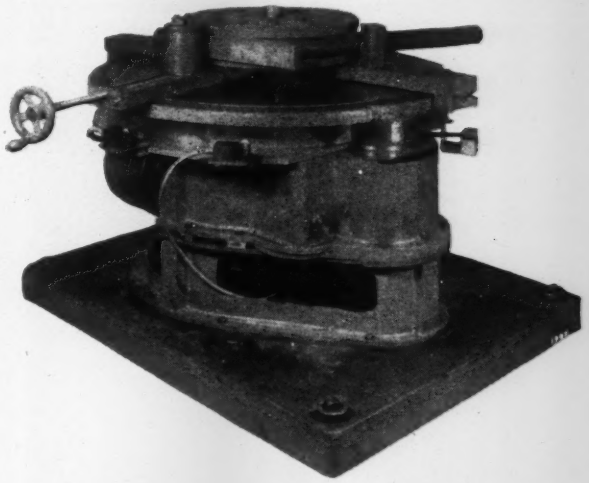
The authors intentionally omitted all descriptive material of air conditioning apparatus, and no photographs of such apparatus are used in any place. The usual subjects of heating systems, boilers, air cleaning devices, sound control, brine systems, piping controls, et cetera, which are found in most air conditioning text books are completely omitted. The title would be more descriptive of the contents if it were The Theory of Refrigeration, Heat Transfer, and Air Conditioning, rather than Refrigeration and Air Conditioning Engineering.

Due to the omission of the above material the book does not seem too well suited to the usual first course in heating, ventilating and air conditioning as given in most engineering colleges, without the use of considerable supplementary material. However, every serious student of air conditioning who is engaged in research, design, development, or application would do well to include this book in his technical library. It is a fine addition to the literature, and supplements the more elementary works in the field.

The publisher is John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. There are 291+ vii pages, 6 by 9 in., with 18 folding charts. The price is $4.00.—Reviewed by N. C. EBAUGH, head of the mechanical engineering department, University of Florida, and consulting engineer.

List of American Standards

A new list of all American standards and war standards approved to date has been published by the American Standards Association, 70 E. 45th St., New York 17, N. Y., and is available free of charge. There are approximately 800 standards listed in the booklet, covering specifications for materials, methods of tests, dimensions, definitions of technical terms, procedures, etc., in the electrical, mechanical, building, transportation, textile, and other fields.



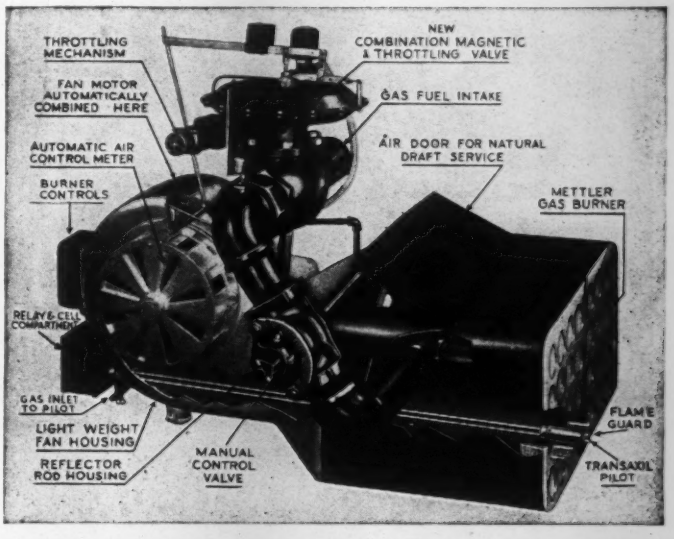
7 REASONS WHY YOU SHOULD OWN A PEDRICK PRODUCTION BENDER

1—It will bend pipe to compound systems in multiple planes.
2—It will bend serpentine coils of finned or plain tube.
3—It will bend box coils of finned or plain tube.
4—It will bend helical coils of pipe or tube.
5—By the addition of a few inexpensive controls, it can be made to do all of this work automatically.
6—It will do all this work at production speeds.
7—High production means low cost production.

To realize greater profit, bend your pipe and tube on a Pedrick Production Bender.
No heat or internal mandrel required.

PEDRICK TOOL & MACHINE CO.
3640 N. Lawrence St. Philadelphia 40, Pa.

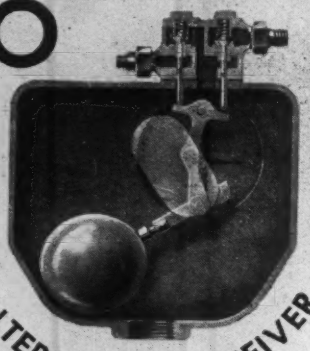
The Mettler "FAN-AIR" Gas Burner
LATEST MODEL FEATURES



Notably—A MECH'L DRAFT AUTOMATIC gas burning SYSTEM embodying electric and throttling control with "TRANSAXIL" FLAME GUARD PILOT—all properly combined for safe, efficient combustion. THE PICTURE REVEALS SOME TANGIBLE ADVANTAGES OF THIS MODERN BURNER AND IT'S EASIER TO INSTALL, TOO.
SIZES 5 TO 300 H.P. PROMPT SHIPMENTS

Mettler Entrained Combustion Gas Burners
FOR ALL Purposes Kinds of gas Pressures
Write for Catalog
LEE B. METTLER CO.
406 S. Main St. Los Angeles, Cal.

SARCO



ALTERNATING RECEIVER

Efficient operation of vapor heating systems requires the return of all water of condensation to the boiler without allowing it to build up in the returns. This is efficiently accomplished by the Sarco receiver or boiler return trap shown..

It collects the condensation and discharges it periodically to the boiler.

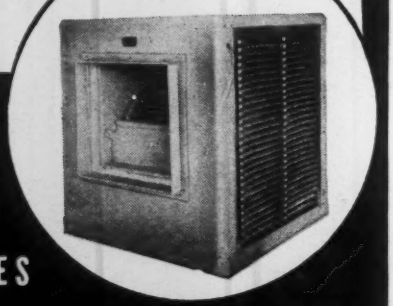
Available in four sizes and capacities, up to 14,000 sq. ft. direct radiation. Ask for Catalog No. 165.

SARCO SAVES STEAM

SARCO COMPANY, INC.
475 Fifth Avenue, New York 17, N. Y.
SARCO CANADA, LTD., 85 Richmond St. W., TORONTO, ONT.

187

SNO-BREZE



THE COOLER THAT'S BACKED BY 3 DECADES OF MANUFACTURING EXPERIENCE

For over 30 years Palmer of Phoenix has been continuously making and trying out evaporative coolers in the testing ground of coolers: the Arizona desert...to achieve the perfected 1945 model Sno-Breze.

Palmer Manufacturing Corp.
Phoenix, Arizona

• WPB . . . OPA . . . PAW . . . Etc. •

[See also page 388, editorial section]

Revoke Most Controls on Installation of Plant Facilities by Utilities

Revocation of virtually all controls on installation of facilities by public utilities was announced last month by WPB's Office of War Utilities.

The new policy permits utilities to make any addition to plant on an unrated basis, except construction of buildings with a materials cost in excess of $25,000, without prior authorization from Washington. Building projects costing less than $25,000 worth of materials will also be permitted on an unrated basis without authorization. Removal of these controls, the OWU estimates, will result in utility expenditures for plant expansion next year approximately twice the total volume of 1943 and 1944.

More Fractional Horsepower Motors Fourth Quarter Possibility, WPB Says

Production of fractional horsepower motors may increase to a total of 800,000 units per month by the fourth quarter of 1945, WPB officials said recently. They pointed out that with the continuing large military demand for small motors, there may be for some time a larger civilian demand than the industry can meet.

Order L-341 is being retained, and will require con-

DE-STA-CO
Blower Wheel Housings

of Standard Dimensions

Made in sizes to fit 4½, 5, 6, 7½ and 9 inch wheels and in widths to suit single or double inlet wheels . . . also individual parts for your own assembly.

De-Sta-Co housings are engineered for maximum efficiency and quietness in operation . . . neatly finished. Send for "De-Sta-Co Blower Housings" bulletin; gives complete information, including essential dimensions.

DETROIT STAMPING CO.
Established Over 30 Years
337 Midland Ave • Detroit 3, Mich.

tinuous inventory reporting by those who use more than 450 such motors per quarter. Thus small users will be protected and should be able to fill their needs, WPB said. Order L-123, which required priority rating to place orders for fractional horsepower motors, has been revoked.

Heating and Plumbing Distribution Order Retained

The plumbing and heating distributors industry advisory committee recommended retention of order L-79 governing distribution of this equipment, WPB reported last month. The order helps to maintain even distribution, the committee said, and its recommendation was accepted by WPB.

WPB Reports on Items in Short Supply

A list of 101 items that "are now or are expected to be in short supply" has been submitted to WPB in the first report of the newly appointed joint committee for critical materials and products, it was announced last month. Among the listed items are anthracite and bituminous coal; temperature and combustion controls; lead; fractional horsepower motors; integral horsepower a-c motors; malleable iron pipe fittings and unions; cast iron radiation; cast iron soil pipe; seamless pipe and tube; iron and steel lubricated plug valves; and bronze valves of 100 psi SWP and over.

Ratings for Motor Repairs

Repairmen using the ratings assigned by controlled materials plan regulation 9-A or a service organization operating under order P-126 may employ the ratings to

Just use it once—

The Alnor Velometer

gives you instantaneous, direct readings of air velocity in feet per minute. Hold it in the air stream for low range readings; use the tube-connected special jets for high range readings or inaccessible locations. That's all there is to it, and once you use the Alnor Velometer you will never tolerate other methods.

The Alnor Velometer is built in several standard ranges from 20 fpm to 6,000 fpm, and up to 3 inches static or total pressure. Special ranges available as low as 10 fpm, and up to 25,000 fpm and 20 inches pressure. Write for Velometer bulletin.

ILLINOIS TESTING LABORATORIES, INC.
420 NORTH LA SALLE STREET
CHICAGO 10, ILLINOIS

And Keep It Out With

AUTO-VENT AIR ELIMINATORS

Venting Hot Water Unit Heater

Circulation Troubles?

Don't fight air pockets or traps in hot or cold circulating lines! "Get that air out of there" *and keep it out* simply by installing the No. 7 Maid-O'-Mist Automatic Air Vent. This reliable air vent has a self-closing float-controlled valve and is designed especially for circulating pipe lines, concealed radiators, unit heaters, cooling manifolds, tanks, diesel engines, or any other application where air pockets or traps retard the free circulation of liquids. Now available in bright brass finish. For pressures up to 75 pounds.

APPROVED FOR NAVY, MARITIME COMMISSION AND ARMY USE

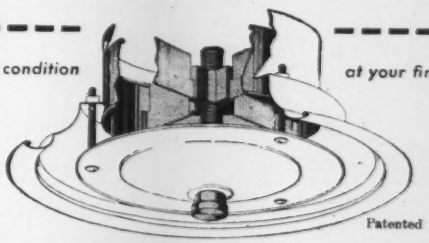
MAID-O'-MIST INC.
3215 N. PULASKI RD.,
CHICAGO 41, ILLINOIS

AUTOMATIC HUMIDIFIERS
FOR ALL TYPES OF HEATING SYSTEMS

How to control supply-air diffusion
to meet specific job requirements and occupant desires.

Direction and volume of air discharged by every KNO-DRAFT Air diffuser can be adjusted quickly and accurately at any time for system balancing, ceiling heights, seasonal requirements, temperature differentials and the desires of the occupants.

Any desired condition *at your finger tip.*



KNO-DRAFT *Type K Adjustable Air Diffuser with Type D Volume Damper*

By simply turning the air adjustment screws (easily accessible from under the unit), the inner cone may be raised or lowered to secure any angle of air direction required. The built-in volume damper (regulated by the hand-turning knob) varies the air outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

Free Handbook: *Contains clear sketches, charts, dimension prints and instructive text that simplifies the selection and installation of air diffusers. Write Dept. D-5.*

W. B. CONNOR ENGINEERING CORP.

Air Diffusion — 114 E. 32nd Street
Air Purification — WB CONNOR
Air Recovery — New York 16, N. Y.

"COMMERCIAL"

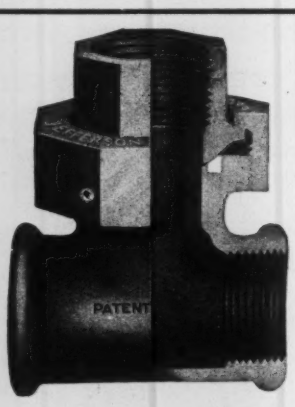
STEEL FURNACE HEADS
RADIATOR CRESCENTS
FLUE COLLARS

All "Commercial" parts for furnaces are formed cold and in one piece, without cracks or folds. From this method of manufacture, smooth flanges result, which are insurance against leaks. The dimensions are accurate and do not vary with each head or flange and fast, economical assembly is possible.

Send us your inquiries. We can furnish heads in many dimensions and flange lengths.

THE COMMERCIAL SHEARING & STAMPING CO.
Youngstown, Ohio

THE UNIONS WITH THE RECESSED BRASS SEAT



JEFFERSON SPECIALTY UNIONS

Effect Big Savings in Labor

Jefferson Union Tees with union on the outlet assure labor savings and better piping jobs because they take the place of an all-female union, two nipples and an ordinary tee. Three joints are thus saved. Available in All-Female and Male and Female threads.

The brass seating in these and all Jefferson Specialty Unions is an exclusive feature which, located in a recess away from the runway of the fitting, leaves a straight bore assuring unrestricted flow in the pipe.

JEFFERSON UNION CO.
601 West 26th Street, New York 1, N. Y.

Factories at
Lexington 73, Mass. Lockport, N. Y.

get motors repaired, rewound, or rebuilt if they are used in such products as oil burners, coal stokers, etc., or in commercial refrigerating systems despite provisions of paragraph (f) (2) (iii) of priorities regulation 3, the WPB ruled June 22. The action was taken by issuing direction 5 to CMP regulation 9-A (parts and materials for repairmen). Order P-126 governs material for emergency servicing of commercial refrigerating and air conditioning systems.

Restrictions Eased on Steel, Copper, Electrical Materials

Restrictions on the use of steel, copper, and electrical materials in construction work specifically authorized by WPB subject to schedule A to CMP regulation 6 (construction limitations) have been eliminated by an amendment to that schedule, WPB reported last month. Restrictions on the use of lumber, tin, lead, and zinc have been retained in the amended regulation with only slight changes.

Builders who have previously received form GA-1456 authorizations may now take advantage of these changes.

Provisions of appendix II of this schedule on the use of ratings for equipment have been modified. With the exception of oil fired and natural gas fired equipment, any equipment that can be obtained without a rating may now be installed under the project authorization.

More Priority Assistance for Housing Construction

Greater leeway in using priorities assistance for obtaining materials for housing construction specifically

Insure Continuous Production by Sealing Pipe Joints

with KEY Graphite Paste

Leaky pipe joints mean lost man hours. You can insure continued production by sealing pipe joints with Key Paste.

Key Graphite Paste is the leak-proof compound to be used on all lines or connections carrying oil, gasoline, and high pressure steam.

Joints sealed with Key Paste will not leak again as it expands when heated, forming a perfect seal. It is more economical to use than ordinary pipe dopes because it gives greater coverage. It will not freeze the connection nor harden in the can.

To avoid shutdowns due to leaky connections try Key Graphite Paste. Your jobber will supply you or write for liberal free samples.

Send for free sample
or order direct from your jobber

THE KEY Company
261 McCasland Avenue • East St. Louis, Illinois

approved by the National Housing Agency was announced last month by the WPB.

This action is made effective by an amendment to the war housing critical list—schedule I of preference rating order P-55-c. Applications for NHA approval are made to the local field offices of the FHA on form WPB-2896, and approval constitutes authorization to begin construction under the WPB construction order, L-41.

The action permits the use of the AA-3 rating and allotment symbols H-1, H-2, or H-3 assigned by the order for all materials to be used in projects approved by NHA except as specifically prohibited or restricted by schedule I and schedule II (war housing construction standards) of the order.

New Construction Volume Estimated

The volume of new construction, both private and public, is expected to total slightly more than $4 billion during 1945 and should increase to about $5.8 billion next year, provided war production has been substantially reduced by the middle of 1946, according to revised estimates prepared by the market analysis committee of the Producers' Council, national organization of manufacturers of building materials and equipment.

"Although the estimate for the current year shows only a slight increase over the amount of new building reported for 1944, the committee's forecast anticipates a rise of 42 per cent in the volume of new private construction, as compared with last year," Wilson Wright, chairman of the council's committee, stated.

HUMICLEAN

Prevents ALGAE AND SLIME IN AIR CONDITIONING

NOT A SCOURING AGENT . . .

A Proven Preventive

★ *Reduces Bacterial Content* in air going thru system from 60 to 90%.

★ *Reduces Labor* because frequent cleaning of jets and baffle plates is no longer necessary.

★ *Proved and Accepted,* has been used by large firms for over 4 years.

★ NON-VOLATILE . . . ODORLESS.

CAROLINA ANILINE & EXTRACT COMPANY

CHARLOTTE 1, N. C.

PEERLESS PUMPS

Peerless

NOW MANUFACTURES

HORIZONTAL

AS WELL AS

VERTICAL

PUMPS

...WITH THE ACQUISITION OF

DAYTON-DOWD COMPANY

BY THE PEERLESS PUMP DIVISION

Peerless Pumps

VERTICAL & HORIZONTAL

PEERLESS PUMP DIVISION Food Machinery Corp.

LOS ANGELES 31, CALIF. 301 W. Ave 26 ★ QUINCY, ILLINOIS 2nd and York Sts. ★ CANTON 6, OHIO 1250 Camden Ave., S.W.

Janette Blower Wheels

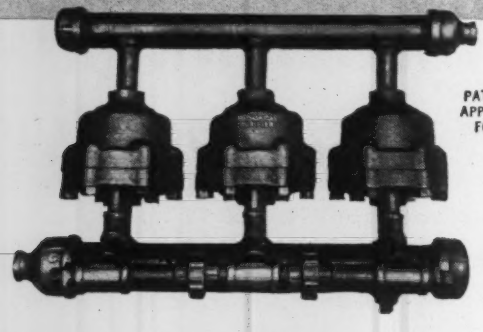
5 in. to 12 in.

DISTINCTIVE FEATURES — The soft steel blades are made in pairs, pressed thru slots in the heavy steel back plate, then welded to the plate. The blade tips are pressed thru slots in the inlet disc then bent back against the spring of the steel blades. This ***patented construction*** results in an exceptionally rigid wheel and ***prevents loose blades,*** as no rivets are used in fastening the blades. The heavy cast iron machined hub is riveted to the back plate and will not crack or become loose on the shaft.

Janette

Janette Manufacturing Co. · 556-558 W. Monroe St. · Chicago, Ill.

Purify Any Pressures, Air or Gas, with Bird-White Multiple Unit *Pur-O-fier*



PATENT APPLIED FOR

Three Models Available

Model A-1 furnished with a 1 inch turbo-rotor and will accommodate volumes from 1 to 8 cubic feet.

Model A-2 has a 2 inch turbo-rotor and can accommodate volumes from 10 to 35 cubic feet.

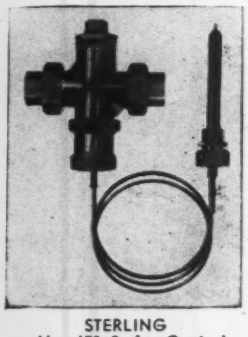
Model A-4 has a 4 inch turbo-rotor and can accommodate volumes from 35 to 100 cubic feet.

Bird-White multiple unit Pur-O-fiers save time and money by protecting air-operated machines, gauges and controls from contamination. They give positive purification to air or gas lines regardless of fluctuating pressures or high volumes.

The perfectly balanced Turbo-Rotor purifying action makes them sensitive to both regular and intermittent pressures. Write for Bulletin 10 giving complete details.

BIRD-WHITE COMPANY
Dept. HP, 3119 W. Lake St., Chicago 12, Ill.

Quick Acting Control for Tank or Processing Temperatures



STERLING
No. 150 Series Control

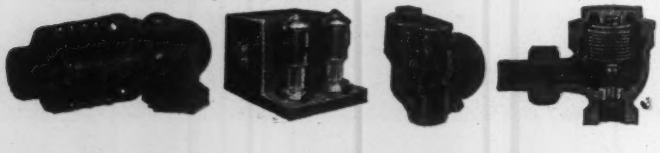
Accurate Temperature Control is ENGINEERED into this Sterling No. 150 Series Control to maintain proper water temperature in storage tanks, dish washers, scalding vats, steam tables, coffee urns, feed water heaters and other similar equipment.

The No. 150 Series operates on steam pressures up to 125 lbs. Being a fully balanced valve, its temperature adjustment is not affected by fluctuating steam pressures. You can depend upon it for efficient temperature control—operates on drop in temperature of 1° or less.

BULLETIN sent you upon request. Your local jobber will quote you.

Fuel Saving Starts With CONTROL

STERLING, INC.
3738 N. HOLTON ST.
MILWAUKEE 12, WISCONSIN



RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 161. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending in your request to Heating, Piping & Air Conditioning.

Circuit Tester

No. 5002—An eight page leaflet issued by Amerline, 1753 N. Honore St., Chicago 22, Ill., describes a vest pocket type electric circuit tester, which indicates circuit conditions by means of varying intensities in the glow of a neon lamp.

Electric Controllers

No. 5003—A 16 page bulletin describing the new "Microact" and other electric type "Pyromaster" controllers has been published by the Bristol Co., P. O. Box 1790, Waterbury 91, Conn. Contact and load-circuit wiring diagrams are given, and typical applications are indicated.

Electric Temperature Controls

No. 5004—A four page bulletin (F-2287-1) has been issued by the Barber-Colman Co., 1228 Rock St., Rockford, Ill., describing the company's electric system of temperature control for heating, ventilating, and air conditioning applications. Also described are motor operated valves, control motors, and package sets of control equipment for hot water storage tanks.

Electrodes and Welding Rods

No. 5005—Page Steel & Wire Div. of the American Chain & Cable Co., Inc., Monessen, Pa., has issued a 33 page digest (DH-821) designed to help in the selection of the correct welding filler metal. A two page index is based on the type and class of material which is to be welded, and the text includes facts about physical properties, the weld metal deposit, operating characteristics, recommended current ranges, and other pertinent information in selecting electrodes and gas welding rods.

Hard Facing

No. 5006—A new 31 page welders' guide on hard facing has been published by the Mir-o-Col Alloy Co., 2416 E. 53rd St., Los Angeles 11, Calif. Included are sections on the effect of heat on metals, the acetylene process, and the electric process. Applications include valves and valve seats.

Heat Exchangers

No. 5007—A four page folder (245) issued by the American District Steam Co., 25 Bryant St., North Tonawanda, N. Y., describes "Adsco" heat exchangers. Among the types illustrated and described are the gravity recirculating heater; an instantaneous, forced circulation, water tube type for special industrial water heating applications; and a heat exchanger for cooling circulating water in air conditioning systems.

Mechanical Draft Gas Burner

No. 5008—A four page, illustrated bulletin (F-3) issued by the Lee B. Mettler Co., 406 S. Main St., Los Angeles 13, Calif., describes the "Fan-Air" mechanical draft automatic gas burner. Mechanical and capacity details of the burners are presented in chart form, and operation of the "entrained combustion" conversion assembly is illustrated.

Push-Pull Control Unit

No. 5009—Arens Controls, Inc., 2267 S. Halsted St., Chicago, Ill., has published an engineering bulletin describing a new tension lock control, which is a compact and lightweight push-pull unit "designed for positive locking on difficult control jobs."

Refrigeration Units

No. 5010—Nine separate two page catalog sheets have been issued by the Air Conditioning & Refrigeration Div., Worthington Pump & Machinery Corp., Harrison, N. J., describing "Freon-12" refrigeration units of types for use with shower condensers and water cooled condensers. Specifications are given for sizes from three to 75 hp.

Vacuum Heating and Vacuum Process Pumps

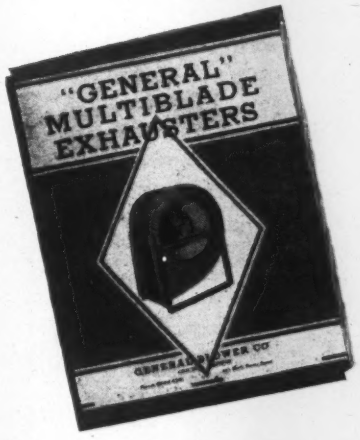
No. 5011—The Whittington Pump & Engineering Co., 245 S. Meridian St., Indianapolis 4, Ind., has recently issued an eight page illustrated bulletin (45) on vacuum heating pumps, containing information on operation, a dimension chart and weights, and a capacity chart. Also available is an eight page bulletin (45-P)

The General Says

ATTENTION

Write today for the complete information which General Blower Co. has prepared for you regarding

GENERAL MULTIBLADE EXHAUSTERS



Ask for Portfolio SC-101—H.P.A.

DELIVERIES 2½ WEEKS

GENERAL BLOWER COMPANY

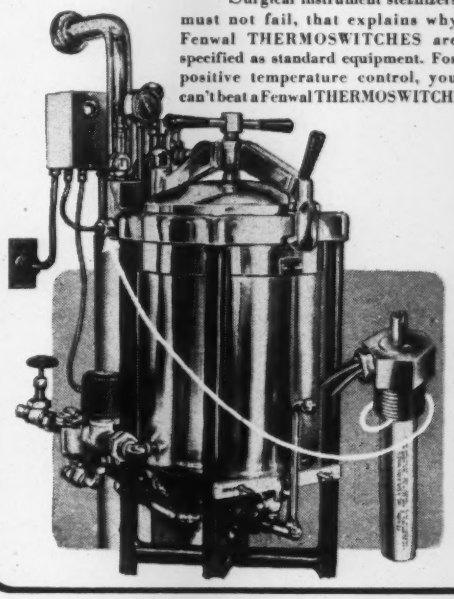
Producers of Air Moving Equipment

401 North Peoria St. Chicago 22, Illinois

GERMS DIE HERE

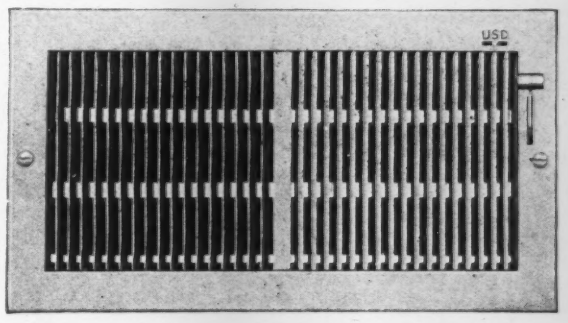
. . . under temperature control!

Surgical instrument sterilizers must not fail, that explains why Fenwal THERMOSWITCHES are specified as standard equipment. For positive temperature control, you can't beat a Fenwal THERMOSWITCH!



Write for catalogue and complete information . . . to

Fenwal INCORPORATED ASHLAND · MASS.



No. 4432

AIRO-FLEX ADJUSTABLE

AIR DIRECTIONAL REGISTERS

Auer Airo-Flex Registers furnish effective 4-way directional flow. Multi-louvre back-blades control up-and-down flow, and indicator on face shows position of blades. Vertical grille bars are easily adjustable for straight or sideway deflection, with turning tool. The Airo-Flex design has all adjustable features of many higher priced registers. Furnished for wall or baseboard use, with matching intake.

Many other styles of Auer registers for both air conditioning and gravity systems shown in Auer Register Book, sent on request. For flat stamped metal grilles, ask for catalog "G."

THE AUER REGISTER CO.

3608 Payne Avenue, Cleveland 14, O.

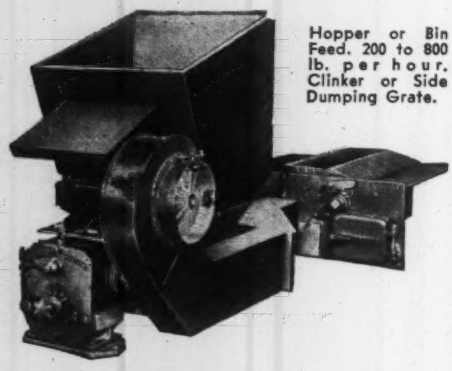
AUER REGISTERS

& GRILLES · For Air Conditioning *and* Gravity

IS ALL THAT COAL NECESSARY?

In many heating plants tons and tons of coal are wasted annually through inefficient stoking. High in price and hard to get . . . coal should be turned into heat with a minimum of waste.

Engineered to conserve fuel, a Frederick Stoker installation insuring thorough combustion and maximum utilization of heat giving gases results in lower coal consumption.



Hopper or Bin Feed. 200 to 800 lb. per hour. Clinker or Side Dumping Grate.

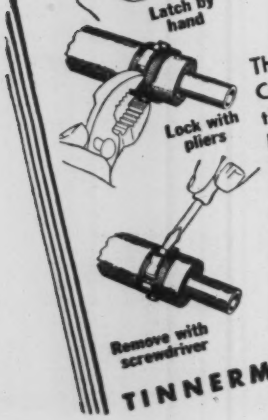
May we mail you our Stoker Catalog? It describes Frederick engineering features in detail. Learn about the fully active grate surface—no dead plates . . . continuous speed type transmission . . . completely enclosed windboxes and mechanism. Frederick Stokers are DESIGNED to give MORE heat with LESS coal. Write for catalog . . . today!

WE ALSO MANUFACTURE fine Centrifugal Pumps . . . especially designed for efficient service in a specific industry. Engineering consultation available without obligation.

THE Frederick IRON & STEEL CO.
Frederick, Maryland

STOKER SPECIALISTS SINCE 1918

THE *New* TINNERMAN HOSE CLAMP



This one-piece, ratchet type Hose Clamp is easily latched by hand, then quickly locked with pliers. Removed by prying locking tongue out of ratchet teeth with screwdriver. It weighs less, has a lower profile, exerts uniform pressure, and may be used over and over again. Approved by Army and Navy Air Forces. Sizes from ½" O.D. up. Write for details.

TINNERMAN PRODUCTS, INC.
2018 Fulton Road, Cleveland 13, Ohio

describing vacuum process pumps. Included in the latter is information on a "Hydro-Scavenger" machine for handling liquids containing abrasives, solids, etc., and used for cleaning out pits, vats, machinery sumps, "Rotoclones," etc.

Welding Library

No. 5012—A four page leaflet issued by the A. F. Davis Welding Library, Ohio State University, Columbus 10, Ohio, urges engineers doing original research on welding to send their papers to the library for permanent filing and future use by the industry. The library also wishes to make its collection of welding patents the most complete in the world, and asks that the numbers of any patents pertaining to welding be sent it.

Rated Orders for Condensing Units Prevent Early Shipments

The removal of certain WPB limitation orders has led customers to expect immediate delivery of condensing units, although rated orders now on manufacturers' books prevent the early shipments desired.

Concern over this condition was expressed at the June 26 meeting of the Refrigeration Condensing Unit Manufacturers Association, and the association advised the chairman of the WPB that with "the shortage of components, such as fractional horsepower motors, fin and tube condensers, and compressor body castings for our complete assembly, we find a backlog of orders carrying ratings which is becoming exceedingly unmanageable.

"The shortage of these components are all natural brakes on our production which we are unable to expand to absorb the increasing demand. In view of these natural brakes, we urge consideration of the following:

"A. A direction to priority regulation No. 1 to hold AA-5 ratings under priority regulation 25 in line so as to insure scheduled deliveries being met.

"B. A re-examination of the field processing instructions to the WPB regional offices, allowing uprating of past individual ratings, and the issuance of a minimum AA-3 to insure these individual requirements being met.

"C. The establishment of a new rating between AA-1 and AAA which would over-ride the present AA-1 rating to insure proper identification of and quicker delivery of military orders.

"The issuance of the direction suggested above in 'A' would definitely be of great assistance to all holders of spot authorizations under priority regulation 25."

PAPER IS A WAR MATERIAL!

Salvage All You Can

MEETINGS & CONVENTIONS

Stoker Makers Streamline Meeting

Arrangements have been completed to hold the annual meeting of the Stoker Manufacturers' Association at the Stevens hotel, Chicago, August 22. This meeting will be a one day business conference, streamlined to conform with government regulations governing the holding of meetings. Business sessions will be held in the morning and afternoon with a group luncheon and the annual dinner in the evening. In order to comply with government regulations, attendance is restricted to members and associate members of the SMA.

"Products of Tomorrow" Exposition Announced

The first annual "Products of Tomorrow" exposition is being planned for an opening January 18, 1946, subject to wartime exigencies, according to an announcement from Marcus Hinson, general manager of the exposition, which is to be held at the Coliseum, 1513 S. Wabash Ave., Chicago 5, Ill. The exposition is to comprise two main divisions, consumer and industrial products, with the addition of others as the demand requires. Plans contemplate the use of a million square feet to accommodate everyone with a product to introduce.

SAVE FUEL! Conservation of fuels by efficient heating is good engineering and good business always. In wartime, it is a patriotic duty as well!

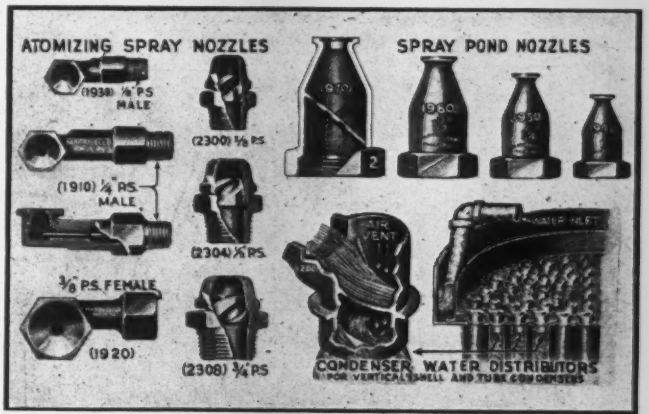
EFFICIENT ECONOMICAL

De Luxe type WK Pressure Actuated Water Regulating Valves for Freon, Sulphur or Methyl, are pilot operated, modulating. Standard adjustable opening range from 50 to 150 lbs. Factory set to open at 90 pounds. Precision engineering and individual testing for low cost, satisfactory performance. Available in sizes of ¾ to 2 inches FPT. Simple adjustment—easily serviced.

Other sizes and types are also available.

Electrimatic
2100 INDIANA AVE. CHICAGO 16, ILL.

QUALITY always wins! MARTOCELLO Products are fully DEPENDABLE



ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, and CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

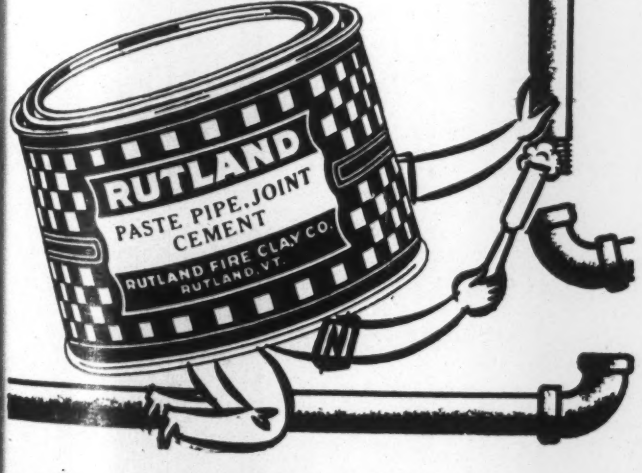
THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their Manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost.

It will pay you to consult us. WRITE or WIRE for further information.

Jos. A. Martocello & Co. 220-230 NORTH 13th STREET PHILADELPHIA 7, PA.

"Serving the Ice Industry Since 1918" . . . "There is no Substitute for MARTOCELLO QUALITY"

The Pipe Joint Cement that goes farther

Rutland Pipe Joint Cement gives you more bulk per pound. That means it goes farther and saves money. Seals joints tightly—lasts indefinitely—yet always leaves pipes easy to disjoin. Remains soft in can. Does not stain hands or fixtures.

Mail post card for free sample. Rutland Fire Clay Co., Dept. H-28, Rutland, Vt. Also makers of Rutland Retort Cement, Furnace Cement, Asphalt Paint, Concrete Patcher.